The Chemical Age

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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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1925

THE year that is just closing is reviewed in this issue from various points of view by experts in their own fields. If it has no notably outstanding feature to distinguish it, the useful retrospect prepared by our conscientious correspondent who has annually performed this service for us will at least recall many points of commercial, personal, and scientific interest. Beginning with overseas trade, one cannot ignore the fact that the value of chemicals exported in 1925 was considerably below that of the exports for 1924 and 1923. The actual figures are £20,735,086 in 1925; £22,575,060 in 1924; and £22,298,012 in 1923. There may be many reasons to suggest that the decline is due to incidental circumstances and need not be regarded as a permanent loss of ground; nevertheless, it is a little disappointing at a time when any sign of overseas expansion would be welcome. The home trade in chemicals has been quiet. Now and again there have been momentary spurts, which have encouraged high hopes, but the forward movement always seems to halt or to be checked before it can get into its stride. Yet, in spite of all this, the year has not been lacking in enterprise and success, while inventive activity has been as brisk as ever.

The articles, published in this issue, by Dr. Maxted Dr. E. F. Armstrong, Mr. W. J. U. Woolcock, Mr. Parrish, our Patents Correspondent, and others review in detail the course of events in different branches. In heavy chemicals, attention has been given mainly to improvements of existing processes rather than to the production of new materials. Of this tendency the ammonium sulphate industry is a fair example. It has been found of late that the ordinary neutral salt tends to cake, and that this defect has resulted in very serious losses of export trade. The remedy would seem to be the production of a fairly large crystal form, and this problem is now being actively investigated by experts. Dr. Maxted's careful review of progress in the nitrogen industry shows that there has been no lack of enterprise in developing the newer processes, and that the tendency, particularly in the case of synthetic ammonia, is towards a considerably greater production than has been attained by plants now in operation. In many respects, as he states, the technology of the nitrogen industry has completely changed during the last fifteen years, and practically the whole of the advances made in manufacture are due directly to pure physical chemistry. Of the state of the fine chemical industry no better estimate could be provided than that which Mr. Woolcock recently prepared. The figures all speak of gratifying progress in the volume of output and especially in the standard of quality. What has been done indicates clearly that this country can develop as good a fine chemical industry as any other, and yet one feels, with Mr. Woolcock, that excellent as the progress is, still more is wanted to complete the work.

The British dyestuffs industry, which for the past few years has attracted so much critical attention, is reviewed briefly but discerningly and fairly by Dr. E. F. Armstrong, looking at the situation primarily as a chemist and as a producer of the needs of the colour user. Truly, as he remarks, seven years is a very short period in which to convert a 90 per cent. import trade into a national industry, capable of meeting the demands of its great colour-consuming industries, and it is an undoubted achievement to have succeeded, at the end of seven years, in meeting 80 per cent. of the colour needs of the country with home products equal in quality to those formerly imported. The demands to-day are increasingly for dyes fast to light and fast to washing, and Dr. Armstrong is not going beyond what the facts justify in claiming that the bulk of the progress in certain directions is due to British effort and serves to show how successful we can be when starting equally with competitors.

One of the most gratifying features of our review is

the continued activity in research and invention. The survey of the new patents of the year supplies some indication of this. In the chemical industries themselves the imperative need of constant and intensive research, if our processes and methods are to be kept even abreast, not to say ahead, of the best competitive practice, is more generally recognised to-day than ever before, though there is still room for progress. Allied with this, is the equally satisfactory tendency in other industries not directly chemical to avail themselves to an increasing degree of the services of chemical experts in order the better to understand their own basic materials and problems. And—perhaps most important because most fundamental of all—at the back of all these industrial applications lies a vitalising interest in pure science, in no direction more marked than in the fields of physics and bio-chemistry.

HCl from the Water Gas Process

ATTEMPTS have been made to produce hydrochloric acid from many sources and by a number of processes differing widely in their means of application. Not the least interesting of more modern developments is the synthetic method worked out by a well-known undertaking in this country, and particulars of which were given in these columns some few months ago. A reader has, however, recently called our attention to the so-called water gas method, and is anxious to obtain not only precise information as regards the reactions and plant involved, but also as regards the extent to which the process is employed. It is an educational experience to have the mind re-focused, by an inquiry of this kind, on processes which one is apt to forget about, and there are no doubt a number of our readers who have never met with the interesting method in question. We believe, however, that the possibilities of manufacturing hydrochloric acid by the interaction of chlorine, steam, and carbon were first recognised some thirty years ago, although the original attempts did not exactly meet with success on a practical scale. Briefly, the plant comprises an ordinary gas generator in which coke is heated to a red heat by an air blast; and, once the required temperature is obtained in the fuel bed, the air is shut off and a mixture of chlorine and steam is passed upwards through the fuel bed. The reaction involved is as follows :—

$$C+2Cl_2+2H_2O=4HCl+CO_2$$

To ensure success in practical operation it would seem that considerable attention must be given to the chlorine-steam ratio, and we notice that comparatively recently a study has been made of the quantitative and other details by Hirschkind in America. This investigator found, by experimenting on a large scale, that by regulating the height of the coke layer in accordance with the rate of admission of the chlorine an exit gas practically free from chlorine and carbon monoxide could be obtained even when the plant was yielding as high as 73 per cent. hydrochloric acid gas. An interesting feature of the reaction from the thermal point of view as compared with technical water gas practice is that the latter process involves a cycle of heat provision and heat consumption. Necessarily, therefore, it is intermittent, and thereby loses efficiency. In the hydrochloric acid process, however, the heat-consuming water gas reaction is combined with the heat-generating chlorination reaction, and for this reason the two reactions can be conducted simultaneously, certainly an important advantage. As regards the utilisation of the process we are not aware of any specific instances of its employment in this country, but it seems to have found a certain amount of favour in America, a notable example being the plant at the works of the Great Western Electro-Chemical Company.

The Sale of Ethyl Gasoline

IN discussing the chemistry of tetraethyl lead in these columns in a recent issue, it was stated that the sale of petrol treated with this "anti-knock" reagent had been prohibited in the United States, following the death of five men engaged in handling ethyl gasoline. It has been rather commonly supposed that certain American States took this course pending further investigation of the toxic properties of tetraethyl lead, but we are pleased to be able to correct this impression on the authority of an important American expert, who is in close touch with the latest developments.

"I have read the article about tetraethyl lead in the December 5 issue of THE CHEMICAL AGE," our correspondent writes, "and I think I should point out that the sale of ethyl gasoline was not prohibited in the United States. No State took any action. New York City had a temporary ordinance against the use of ethyl gasoline, but the cessation of sales resulted by voluntary action on the part of the Ethyl Gasoline Co., who decided to withdraw the material from sale until it could be investigated by an impartial committee. A committee of seven experts was appointed by the Surgeon-General of the United States, and they have been making their investigations and are expected to publish their findings early in the new year. Meanwhile, at the suggestion of this committee, the sale has been resumed in one district, in the State of Ohio. Your readers might also be interested to know that in spite of millions of gallons of ethyl gasoline having been used, there was not a single case of any deleterious effect from the sale or use of it."

Improved Employment Position

WHILE the gross figures of unemployment in all insured industries are important and significant, they do not of themselves disclose the widely varying courses that the several great sections of British industry have taken in the immediate past, as is rightly pointed out in the December issue of the *Ministry of Labour Gazette*. This contains a most useful analysis of the course of unemployment for the past few years, which shows that a wide extension of unemployment in coal-mining, for example, turned what would have been a rapid decrease in the gross figures for the first six months of 1925 into an eventual increase; a tendency towards a decline in unemployment in several of the main export trades in the last two years is apt to pass unnoticed under cover of the all-over figures; and the part played by certain industries in which employment ebbs and flows according to the season of the year also tends to be obscured in the course of the gross figures.

With regard to the course of unemployment between 1921 and July, 1923, when the special analysis was commenced, it will be remembered that the national stoppage in the coalfields in 1921 lasted from the beginning of April until the first week in July. During the remainder of that year and the first half of 1922 the numbers of insured persons recorded as unemployed in Great Britain were very high—the mean for these twelve months being 1,750,822. An improvement was experienced in the latter half of 1922 and the first half of 1923, the average for the twelve months decreasing to 1,362,613. At the end of July, 1923, the total number of insured persons recorded as unemployed in Great Britain was 1,279,144.

An examination of the more important of the staple industries during the period under review shows the outstanding feature to be the great increase of unemployment in the coal-mining industry since April, 1924, which reached a climax for that year of 129,994 in October, the figure having risen to 292,612 by twelve months later. Following the threat of a stoppage in July of this year and the provisional agreement for a continuation of work, the unemployment figures rose again during August and September and fell in October. This improvement may have been due in some measure to seasonal causes and in other measure to the effect of the subsidy and to the increased demand for coal for export owing to the strike of anthracite miners in the United States. The increase of 116,878 between October, 1924, and October, 1925, in the numbers recorded as unemployed in this industry alone, compares with the increase of 55,178 in the same period in *all* insured trades including coal-mining. Excluding coal-mining there was a decrease of 61,700 in all other insured trades taken together; so that, apart from the crisis in the coal industry, the figures would appear to indicate that the general improvement in employment experienced in 1924 has continued during the current year.

The returns for the chemical and allied trades, taken as a whole, also show a better state of affairs than existed a year ago, the decrease in the percentage of unemployed averaging about 1·5, the number of workless people in these trades now being less than 7·5 per cent. of those insured. This improvement covers the group of trades including chemicals, explosives, paint, varnish, japan, red and white lead, oil, grease, glue, soap, ink, match, etc., production, although unemployment in "chemicals manufacture" has risen by 0·1 per cent., a slight increase over the corresponding figure of last year.

A Model Broadcast

An address by Dr. G. C. Clayton, M.P., on "Some benefits conferred on mankind by chemical research," which was broadcast from the London B.B.C. studio last week, and which is reproduced in this issue, strikes one as an excellent model of what such "talks" should be. From the point of view of making the practical value of chemistry popularly understood and appreciated, a ten-minute speech broadcast to thousands who could not otherwise be reached offers a great opportunity; but it is beset by two dangers—the danger of descending into technical depths to which the hearer firmly declines to follow the explorer, and the equal, if not greater, danger of talking in an artificially popular style that the hearer at once detects and probably resents. Dr. Clayton's address very happily avoids both. Taking up points of universal human interest—such as housing, clothing, food, and health—he states in simple terms what the chemist has done and is doing to provide good conditions of life for everybody. As a result of his talk, large numbers of people have notably been made to realise for the first time the part that industrial chemistry plays in providing them with the necessary things to eat and things to wear. It is this kind of broad appeal that the popular interpreters of chemistry so often just miss, and so good an example of a really useful educational chat seems to us to deserve this word of recognition and commendation.

Book Received

Water Sterilisation by Gaseous Chlorine. The Paterson Engineering Co., Ltd., Windsor House, Kingsway, London.

The Calendar

1926 Jan.		
5	Royal Institution: Juvenile Christmas Lectures—"Old Trades and New Knowledge" (IV) "The Trade of the Dyer." Sir William Bragg. 3 p.m.	21, Albemarle Street, London.
5	Hull Chemical and Engineering Society: "Fuel Economy in Steam Plants." Arthur Grounds. 7.45 p.m.	Grey Street, Park Street, Hull.
5	Institute of Metals (Birmingham): "The Influence of Work and Annealing on Brass." Dr. O. F. Hudson. 7 p.m.	Chamber of Commerce, New Street, Birmingham.
7	Institute of Metals (London): "The Fatigue of Metals." J. Gough and Dr. D. Hanson. 7.30 p.m.	85 - 88, Minories, Tower Hill, London.
7	Society of Chemical Industry (Bristol Section): "The Contact Process for Sulphuric Acid." Stanley Robson. 7.30 p.m.	Chemical Dept., University, Bristol.
8	Chemical Engineering Group: "The Manufacture of Hydrogen for Industrial Purposes." A. Edgar Knowles, and others.	London.
11	Worshipful Company of Dyers: "Artificial Silk Dyeing." C. M. Whittaker. 6 p.m.	Dyers' Hall, Dowgate Hill, London.
11	Ceramic Society: "The Scientific Treatment of Feed Water for Boilers." W. B. Lewis. "Chemical Stoneware." W. Green.	Central School of Science, Stoke-on-Trent.
12	Society of Chemical Industry (South Wales Section): Discussion on "The Training of Chemists for Industry."	Technical College, Cathays Park, Cardiff.
14	Oil and Colour Chemists' Association: "Cellulose Nitrate Lacquers." A. E. Lain. "Leather Japanning." A. W. Lattey.	8, St. Martin's Place, Trafalgar Square, London.
15	Institute of Chemistry and Society of Chemical Industry (South Wales Sections): "Modern Resistance Glasses." E. E. Ayling.	Technical College, Swansea.
15	Institute of Metals (Swansea): "The Wire-Drawing Process." Professor E. C. Thompson. 7.15 p.m.	University College, Singleton Park, Swansea.
18	Institute of Chemistry (Manchester Section): Discussion on "Chemical Nomenclature," to be opened by C. Hollins.	Manchester.
19	Royal Institution: "X-Rays and Living Matter." James A. Crowther. 5.15 p.m.	21, Albemarle Street, London.

1925 : A Retrospect

Chemical Industry, Chemical Science, Chemical Organisations

THE closing year has been a period of great prosperity for the artificial silk industry, the rubber-producing industry, and a few of the other industries in which chemical operations are involved. It has been a period of depression for the coal industry, the shipping industry, the oven-coke industry, and the iron and steel industries. For chemical industries generally it has been a period of dullness but not of acute depression. The figures for the year relating to the export of chemicals, dyes, drugs, and colours so far available are disappointing, but are as favourable as could be expected in view of the depressed condition of many industrial undertakings that are in normal times large consumers of chemicals. The abnormal values of many foreign currencies and the fact that in many European countries operatives are working a long working day and receiving a low wage, compared with the working hours and the wages common in this country, are factors which make it difficult to sell British goods in some of the foreign markets. Nevertheless, those who heard or read the speeches of the chairmen of Brunner, Mond and Co., of the United Alkali Co., of Nobel Industries, and of other chemical manufacturing companies at their annual general meetings are aware that in spite of all trading difficulties great activity has prevailed in certain chemical industries, and progress has been made in the design and erection of new chemical plant. In addition to the erection of much new plant for the production of beet sugar and of artificial silk, mention may be made of the completion of the new ammonia-soda works at Wallerscote for Brunner, Mond and Co. It is believed that at Wallerscote it will be possible to produce sodium carbonate at a cost lower than the lowest cost at which it can be produced in any other factory in the world. Reports received towards the end of the year indicate that already a revival of the demand for many British goods has commenced, and that the trade in heavy chemicals is expanding. In May the British Empire Exhibition was reopened, and the Chemical Section again attracted a large number of visitors. This section was admirably arranged, and showed how intimately chemistry and chemical industries are involved in the daily operations of the community. The exhibition closed on the last day of October.

The Chemical Societies

A little further progress has been made during the year in the work of bringing together all interested in the development of chemistry and chemical industry. When the London programme for the current session of the ten principal societies that are concerned mainly with chemical science was published, it was announced that each of the ten societies would welcome at its meetings the attendance of any non-member who was a member of any one of the ten societies, provided that he gave twenty-four hours' notice of his intention to be present to the Secretary of the society concerned. This arrangement should be useful in promoting friendship and useful discussion between the members of the various associations.

At the annual general meeting of the London and South-Eastern Section of the Institute of Chemistry, held last month, the Chairman, Sir Robert Robertson, appealed to the members to pull their weight in supporting other chemical societies. He referred to an informal meeting which had been held of the secretaries of the chemical bodies which had formulated the joint meeting card. From their labours some statistics had been obtained as to the number of members common to two or more societies. Out of nearly 1,750 members of this Local Section of the Institute only 628 belonged to one or more of the other societies, the Chemical Society being omitted from the statistics. Of these only 403 belonged to the Society of Chemical Industry. Sir Robert added that he felt that this was a deplorable state of affairs.

An event of importance was the organisation of a meeting described as a " British Chemistry Dinner," which was held in London in November. It was held under the auspices of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry, the Association of British Chemical Manufacturers, the Institution of Petroleum Technolcgists, the Society of Public Analysts, the Biochemical Society, the Oil and Colour Chemists' Association, and the Chemical Industry Club. Dr. Ormandy, chairman of the Chemical Industry Club, presided over the meeting. Professor J. F. Thorpe, speaking at this meeting, said that this was the first time there had been such a gathering of British chemists and British chemical industry, and he regarded it as one of the firstfruits of the recent endeavours to bring about greater co-operation. Mr. Woolcock also addressed the meeting, and said that he felt confident from such a gathering, at which every chemical society in England was represented, that our prospects in chemical industry in this country were second to none in any part of the world.

Another event of interest was the formation of a North of England Section of the Society of Public Analysts at a meeting held in Manchester in February. The first meeting of this section was held in Leeds in June, and other meetings will be held in other towns in the north of England.

In June chemists and other men of science met together at the Royal Institution to celebrate the centenary of the discovery of benzene by Faraday. A lecture on " Faraday as a Chemist " was delivered by Sir William Pope, and delegates from abroad came to express their appreciation of the work Faraday accomplished and of the discoveries he made. In honour of the occasion a banquet was held at the Goldsmiths' Hall.

In October a British delegation, including Professor H. E. Armstrong, Sir Robert Hadfield, Sir William Pope, and Sir F. L. Nathan, went to Paris to attend the fifth Congress of Industrial Chemistry organised by the French Society of Chemical Industry.

Registration of Chemists

The proposal to compile and maintain a register of all chemists continues to be discussed. Dr. E. F. Armstrong, speaking at the annual meeting of the British Association of Chemists on October 31, said that the Institute of Chemistry at its conference in York apparently agreed with the Association that there must be a body established for the purpose of registering all chemists, and there were indications that some solution of the problem would be possible in the future. The American Chemical Society, he said, wielded enormous influence because it spoke with one voice for all chemists.

In November Mr. Garland, in an address to the London Section of the Society of Chemical Industry, said that the Registrar of the Institute of Chemistry had written to some of the other societies and suggested the formation of a Joint Committee to consider the registration of chemists. That, said Mr. Garland, was a thing everyone desired.

Discordant Analyses

It is well known that analyses of the same material made by different analysts sometimes differ materially, even when the analyses are made by skilled analysts of high repute. These differences are commonly due to the use of different analytical methods or to differences of detail in operating the same method.

These discordances tend to throw discredit upon the work of analysts generally, and it was suggested by Messrs. C. H. and N. D. Ridsdale, in a paper communicated in May to the Society of Public Analysts, that a body of analytical chemists should draw up and publish a series of standardised methods of analysis for certain articles of commerce which should be used by all analysts. It is urged that the Society of Public Analysts should publish in full detail the descriptions of the processes, and should emphasise the fact that any deviation from the detailed operations may lead to error. It is very disconcerting to buyers and sellers, said Messrs. Ridsdale, for a referee chemist suddenly to alter the method he uses, even though he may increase its accuracy. It is not suggested that chemists should restrict themselves to standardised methods when making analyses for purely scientific purposes.

The value of the work which has already been done in the direction indicated is appreciated, especially the work of the United States Bureau of Standards, but it is urged that more could be done for the assistance of British analysts engaged in commercial work.

British Dyestuffs

During the year Dr. E. F. Armstrong was appointed managing director of the British Dyestuffs Corporation, Ltd., and a reconstruction scheme was adopted. The Government surrenders its rights of veto and control, and is to receive £600,000 upon surrender of all its shares, consisting of 850,000 preference shares and 850,000 preferred ordinary shares. The Corporation will still undertake that not more than 25 per cent. of its voting power shall be held or controlled by foreigners, and it will keep in touch with the Government in all matters of technical research and information in such manner as the President of the Board of Trade may direct.

Gas Company's Caustic Soda

In June in the House of Lords the appeal of Mr. J. L. Deuchar relating to the manufacture of caustic soda by a gas company was dismissed. It may be remembered that Mr. Deuchar, secretary to the Castner-Kellner Alkali Company, endeavoured unsuccessfully to obtain in the lower Courts a declaration that the manufacture of caustic soda by the Gas Light and Coke Company of London was *ultra vires*. Mr. Deuchar appealed to the House of Lords against the decision of the Court of Appeal, which supported the decision previously given by Mr. Justice Astbury. The Lord Chancellor, in moving that the appeal be dismissed, held that the Statute did authorise the company to convert its naphthalene into beta-naphthol and to provide the necessary materials for that purpose. He saw no reason why the materials should not be provided by the process of manufacture. If it could be suggested that the company were engaged in manufacturing caustic soda for the purpose of sale the result, he said, might be very different, but it was plain from the evidence that they were making caustic soda only for the purpose of using it in the process of converting one of their residuals into a marketable product. Lords Dunedin, Atkinson, Sumner, and Buckmaster concurred.

Synthetic Methanol

Much attention has been given during the year to the production of synthetic methyl alcohol, or methanol. In the United States methanol has long been obtained in large quantities by the distillation of wood, and it appears probable that this industry will be adversely affected by the importation of cheap synthetic methanol from Europe, or by the manufacture in America of methanol by a synthetic process. In a report to the Chemical Division of the United States Department of Commerce from the Trade Commissioner in Berlin, published late in the year, it was stated that the Badische Anilin und Soda Co. owns and operates the new synthetic process. Also that German official figures show that during the first five months of this year Germany exported 578 metric tons of synthetic methanol to the United States; 746 tons to Great Britain; 490 tons to Russia, and 469 tons to Switzerland. The methanol is produced by causing carbon monoxide and hydrogen to combine in the presence of a catalyst, probably finely divided zinc oxide, maintained at a temperature of about 400° C. The combination of the gases is effected under a pressure of 200 atmospheres. Purified water-gas may be used as the mixture of carbon monoxide and hydrogen. The apparatus is of a type similar to that used in the Haber-Bosch process for making ammonia by effecting combination between hydrogen and atmospheric nitrogen.

Home Grown Sugar

Those who for many years past have been endeavouring to establish the cultivation of sugar beet and the manufacture of sugar therefrom as a national British industry of primary importance have reason to feel gratified with the substantial progress which has been made during the present year towards the attainment of their object. The Anglo-Scottish Beet Sugar Corporation has doubled the capacity of its first factory at Colwick, near Nottingham, and a factory has been erected at Spalding, where the Kidderminster Corporation has also erected a factory. A second Anglo-Scottish Beet Sugar Corporation has been formed to erect three new factories, one near York, another at Felstead, in Essex, and a third in the county of Fife. In October a beet-sugar factory was opened at Ely by the Minister of Health. He said that eight new factories were contemplated and six would be ready shortly. It is estimated that the Ely factory will have an annual output of 15,000 tons of sugar. A beet-sugar factory is also to be built at Selby by the United Sugar Co., Ltd., the directors of which include Sir Ernest Tate and Sir Leonard Lyle. The Orchard Sugar Co., Ltd., has acquired a sugar refinery at Greenock to operate on British beet. The Sankey Sugar Co. has been reconstructed with an increased capital with the object of building a beet-sugar factory in conjunction with its refinery at Earleston to operate on sugar beet grown in Lancashire and Cheshire.

The British Sugar Beet Society has adopted the report of a special committee on the training of technical officers for beet-sugar factories. The report states that the technical posts offered in a beet-sugar factory are comparatively limited. For, say, 50 factories the number of posts will be 400 to 450, including "campaign" chemists. The Committee recommends that preference in appointments to vacancies shall be given to applicants holding the diploma in beet-sugar technology.

In the House of Commons it was announced last month that on June 4 last 56,200 acres were returned as under sugar beet cultivation in Great Britain, and that it was estimated that 57,000 tons of refined beet-sugar would be produced during the season 1925-26.

Artificial Silk

This year has been a period of remarkable activity and prosperity for the artificial silk or rayon industry. The United States of America come first in order of importance as makers of this material, and Italy is said to be the second largest producer, but in this country also rayon manufacture is a large and expanding industry. Replying to a question in Parliament in May, Sir A. Steel-Maitland said that according to information in possession of the Home Office there were 27 factories and one workshop engaged in artificial silk manufacture. This figure included six factories and one workshop engaged in artificial silk winding, one factory engaged in bleaching, and five factories in artificial silk dyeing.

Mr. Roscoe Brunner, speaking at the last general meeting of Brunner, Mond and Co., said that the artificial silk trade had expanded greatly in the last five years. The chemical trade supplied large tonnages of various materials to the artificial silk trade, and they themselves were looking forward to supplying them with largely increased quantities.

During the last few months arrangements have been made for the establishment of several new artificial silk factories in different parts of the country.

Sulphate of Ammonia

The fifth annual report of the British Sulphate of Ammonia Federation published last month shows that for the year ended May 31 last there was an increase of about 11 per cent. in the consumption of all forms of nitrogen. The increase in the consumption of sulphate of ammonia during the year was about 10 per cent. The average price obtained by members of the Federation for neutral sulphate was £12 5s. 6d., a reduction of nearly 8 per cent. on the price obtained in the previous year. The present low level of sulphate of ammonia prices is undoubtedly due, says the report, to the great economic pressure which is being exercised in Germany, and there is every indication that the average price for the current year will be substantially lower than that obtained for the year under review. Fortunately, the low price of sulphate is stimulating the demand for it, and it is hoped that the expansion in demand may prove sufficient to absorb the output of the new synthetic plants which may be expected to be in operation shortly in Italy, France, and Belgium, and of the extensions of existing plants in Germany and Great Britain.

With regard to the British export trade in sulphate of ammonia the two main features mentioned in the report are a gain of 49,000 tons in the quantity exported to Spain, an increase of 46 per cent. for the year, and a loss of about the same quantity in the amount exported to Japan. The Federation regrets to have to record that very considerable trouble has been experienced, both at home and abroad, owing to the tendency of powdery neutral sulphate to cake.

This vexatious difficulty has cost the Federation the loss of 57 per cent. of its Japanese trade. A technical committee has diagnosed the causes of the caking, and it is hoped that sulphate makers will put into practice the committee's recommendations.

Platinum in South Africa

Platinum is so useful for many chemical and electrical purposes that the discovery of new sources of the metal is a matter of importance to chemists generally. It is regrettable that a metal which is so scarce and so much wanted for scientific work and for dentistry is being used in large quantities by jewellers. During the year keen interest has been taken in the prospecting which has been carried on over a large area in the Lydenburg district of the Transvaal. Platinum has been found over an area extending for many miles, but most of the reports so far published indicate that the platiniferous rock contains only a few dwt. of platinum per ton. It is not yet certain that the platinum can be profitably worked on a large scale, but it is confidently predicted that it will be, and many companies have been formed to work the deposits.

The chairman of Lydenburg Platinum Areas, Ltd., speaking at the general meeting of the company held in August, pointed out that in 1918, when the world production was 62,000 ounces, as high a price as £32 per ounce was realised. Doubling last year's production, which was probably 80,000 ounces, to allow for increased output from Russia, the world production outside Africa would be 160,000 ounces. Taking pre-war consumption to have been 300,000 ounces per annum and the probable future consumption when the price of platinum falls to, say, £10 per ounce at 360,000 ounces per annum, this would leave 200,000 ounces per annum to be provided from South Africa. It will probably be many years before the world output of platinum is sufficiently large to cause the price to fall to £10 per ounce. The existence of platinum in the Transvaal has been known for a long time, but it is hoped that the explorations of the present year have revealed a source of platinum of first-rate importance.

British Coal

The export trade in coal this year has been on a reduced scale owing to the cost of British coal being high in comparison with that of foreign coal. It has been suggested that the cost of production might be reduced by inducing the miners to adopt an 8-hours' working day in place of a 7-hours' day. At the end of July the Government prevented a general closing of coal mines by granting a subvention or subsidy for a period of nine months, commencing on August 1 last, to make up the difference between the highest rates of wage the owners will pay and the lowest the miners will accept. What will happen on May 1 next, when the nine months will have expired, is unknown, but a Royal Commission which has been appointed to inquire into the condition of the coal industry has been hearing the evidence of industrial experts and will issue a report in due course. For the three months ended October 31 last the subsidy amounted to over six million pounds.

Petroleum Supplies

Much attention continues to be given to the problem of finding a home-made substitute for the petroleum distillates used as fuel, but no petroleum famine is yet in sight. The supply of petroleum has continued to be plentiful throughout the year and a number of oil wells in California and elsewhere have been closed until the condition of the oil market induces the owners to reopen them. For the first time for many years there was a slight decline in the year 1924 in the amount of crude petroleum produced in the United States, but it is anticipated that the output for the present year will be a little greater than the highest annual amount yet recorded.

The output of oil from Mexico has continued to decline, but there has been increased production in Russia, Venezuela, Roumania, Persia, and Peru. Sir John Cargill, speaking at the last annual meeting of the Burmah Oil Co., when referring to the production of crude oil in the United States, said that not only have new prolific fields been discovered, but deeper drilling in many of the older fields which were showing signs of exhaustion has proved enormously prolific sands at depths that only a few years ago it was not considered possible to reach with the drill. Whenever consumption of oil has shown signs of overtaking production some fresh discoveries of prolific sources of crude oil have, he said, sent production ahead of consumption.

The annual report of the Anglo-Persian Oil Co., in which the British Government is financially interested, was presented at the meeting held in November, and stated that the oil-bearing territory in the Persian Main Fields has again been greatly extended by the bringing in of a number of new wells in various directions. These wells all give the same high rates of yield as those from which present production is being drawn. Drilling operations in other parts of the Persian Concession have been actively continued, and a large additional area of productive territory has been proved. In the Argentine production by this company has continued to increase, and several new wells have been brought in. The amount of oil passed through the refineries at Abadan in Persia and at Llandarcy in South Wales has increased largely. Although little petroleum has been found in this country, the refining of petroleum imported in its crude condition from abroad appears destined to occupy a prominent position amongst our national chemical industries.

Fuel Oil

A long report issued in August by the American Petroleum Institute concerning the oil resources of the United States should be read by those chemists who believe that fuel oil obtained from crude petroleum will eventually be replaced by oil obtained by carbonising coal at a low temperature. The report indicates that there is no imminent danger of the exhaustion of the natural oil supplies, but suggests that the supply of gasoline (petrol) will be augmented by the cracking of fuel oil, and that, in consequence, the supply of petroleum fuel oil will be correspondingly diminished, and thus eventually be removed from competition with coal.

The report of Lloyd's Register for the year ended June 30 last contains some interesting information concerning the use of fuel oil on ships in internal combustion engines instead of for the generation of steam. The report states that the outstanding feature in connection with the development of marine propulsion continues to be the adoption of the internal combustion engine. In some of the smaller motor ships sail power is also available, but about 95 per cent. of the 387 vessels which are of 2,000 tons or upwards are solely dependent upon their motor engines for propulsion. The year is also noteworthy, says the report, for the increasing demand for the double-acting Diesel engine.

Oil Shale

The industry concerned with the production of oil from Scottish shale was again carried on at a loss. Speaking at the recent general meeting of the Anglo-Persian Oil Co., the chairman announced that the part of the organisation of Scottish Oils, Ltd., which is employed in refining Persian oil and marketing the products therefrom is giving satisfactory results, but that, notwithstanding this, the Anglo-Persian Co. has so far received no return on the £1,000,000 of capital which it invested in the company five years ago.

The attempt made by English Oilfields, Ltd., to produce oil on a large scale from the Norfolk oil shale has also proved unprofitable up to the present time. In some other parts of the world also attempts to profitably work oil shale have been unsuccessful, and there appears little prospect of prosperity returning to the workers of oil shale in Great Britain until the output of oil from wells in oil-producing countries fails to satisfy the ever-increasing demand for oil, or until, for some other reason, the market values of oil distillation products increase substantially.

Petrol and Static Electricity

Late in the year a report by the Inspector of Factories concerning the explosion of petrol in a road tank car which occurred at Shell Haven, Essex, in August, 1924, was issued. Two persons were killed and four injured. The report should be read by all concerned with the transport of volatile hydrocarbons in tanks. The ignition and subsequent explosion of the spirit vapour in the tank is ascribed to the generation of an electric spark arising from the discharge of a charge of static electricity produced by the flow of the spirit into the tank. When anhydrous liquids flow through a pipe or nozzle they become charged with one form of electricity

while the pipe becomes charged with the opposite kind. The petrol which was being pumped into the tank when the explosion occurred was spirit known as "S.P.B." (Special Boiling Point), having a boiling range of 100–120° C. This spirit is much less volatile than "Shell" motor spirit, and is used for extracting oil from seed, and possibly for dry-cleaning.

The report draws attention to the number of ignitions which have occurred in dry-cleaning when the mere removal of a silk garment from benzine has been sufficient to produce a spark and cause ignition. It also states that the danger from static electricity has been recognised in the United States of America, where the climatic conditions are often very favourable to its production, and a number of serious petrol fires have been traced to this cause. In one case the petrol caught fire whilst it was flowing into the tank of a private motor car at a filling station.

Details are given in the report of precautionary measures which should be adopted to minimise the risk of the generation of electric sparks during the operation of filling petrol tanks.

Rubber

In nearly all large industrial undertakings rubber is used in considerable quantities for the tyres of motor vehicles, and the abnormal condition of the rubber market during the greater part of the year has attracted widespread interest. The increased demand for rubber by the motor manufacturing industry, and the operation of the Stevenson restriction scheme adopted by plantation companies in Ceylon and Malaya, caused stocks of rubber to be greatly reduced and the price to rise much above the figure generally anticipated.

Last year rubber was selling at about 14d. per lb. This year the price has exceeded 4s. 6d. per lb. for some time, and has exceeded 3s. for a long period. Most large plantations are moderately profitable when rubber is fetching 14d. per lb., and when the average price for the year rises to 30d. per lb. the profits are large. About a year ago many undertakings sold a large proportion of their output for the year 1925 at about 15d. per lb., so they have not profited this year by the high price of rubber as much as might be expected. But for the coming year advance sales have been made at prices which assure very profitable working for the year. Many contracts for the delivery of rubber during the year 1926 have been made at a price of over 4s. per lb. for best quality rubber. The rubber plantation industry has had several very lean years recently, and the present period of prosperity will compensate many of the less successful undertakings for past unprofitable expenditure of labour and money.

Manufacturers of rubber goods have protested against the restriction scheme which has assisted in bringing about the great rise in the price of their raw material, and the instability of the price has made it difficult to estimate correctly the cost of producing manufactured rubber goods. There can be little doubt that production of raw rubber will eventually again overtake consumption, and that a rapid fall in the price of rubber will then occur. It has already been officially announced that for the quarter commencing on February 1st next there will be no restriction of standard output under the Stevenson scheme. It is probable that both producers and consumers of rubber would benefit by a scheme which would keep the fluctuations in price within narrower limits.

Air made Toxic by Cheese

An incident of general interest was reported in a letter from Mr. Parker, the late Government analyst for Auckland, New Zealand, which was published in the September issue of *The Analyst*. Mr. Parker refers to an accident which recently occurred in Auckland and which nearly proved fatal, which was due to gas evolved from cheese. An inspection was being made of the partly filled hold of a steamship by a party of officials, when one of the party fell down unconscious on reaching the cargo, which consisted entirely of crates of New Zealand cheese destined for London. Analysis of the air showed the presence of a very large quantity of carbon dioxide, evidently produced by the cheese. It appears that new cheese in cold storage chambers often evolves a non-respirable gas, and that before working the cheeses arrangements have to be made for the removal of the gas.

Gifts

Great generosity by private individuals and by trading firms towards those engaged in the quest for new knowledge has marked the year. Large sums of money have been given or bequeathed to various British educational and research colleges, and mention may be made here of a few. In response to an appeal for £500,000 for the erection of new buildings for scientific work at Leeds University many trading firms in all parts of England have sent or promised large donations. The Right Hon. T. R. Ferens has offered £250,000 as the nucleus of a fund for founding a University College at Hull. The University College at Leicester has received £3,000 from Messrs. Stead and Simpson for the fund for the endowment of lectureships in chemistry and physics. This college has also received gifts of £20,000 from the late Mr. H. S. Gee and £2,000 from Sir Jonathan North. Glasgow Technical College received an anonymous gift of £50,000. Mrs. Charles Hancock has endowed Girton College with two fellowships each of the value of £3,000. The late Mr. John Stephen bequeathed £2,000 to the University of Aberdeen. The Company of Clothworkers of London gave £18,300 to the University of Leeds for buildings and equipment for the textile and dyeing departments, and promised an additional annual grant of £3,000 for the next seven years to ensure the efficient maintenance of those departments. Messrs. Brunner, Mond and Co. gave £150 to the department of Metallurgy and £150 to the department of Physics of the University of Manchester to aid research work. The United Alkali Co. gave £100 to the Imperial College of Agriculture of Trinidad.

Obituary

Many members of the British chemical associations have passed away during the year, and among those who were widely known in chemical circles the following names have to be recorded:—A. Boake, H. T. Brown, J. Y. Buchanan, C. F. Chandler, W. J. Dibdin, Sir William J. Goulding, F. Grant, T. H. W. Idris, F. R. Japp, Francis Jones, W. R. A. Joyner, E. Knecht, W. R. Lang, Lord Leverhulme, R. W. Oddy, W. J. Palmer, F. G. Pope, D. R. Steuart, I. H. Storey, R. L. Taylor, Sir Edward Thorpe and L. E. Vlies.

Dr. Joyner was a research chemist at the Nobel explosive Factory, Ardeer, Ayrshire. He was experimenting with explosives when a container which he was holding exploded, and he received injuries which caused his death on the following day.

German Synthetic Rubber

RECENTLY the first German crude rubber works, Wiebe and Konsorten, Hanover, have announced that they can produce from potato preparations a rubber which can compete with the natural product, according to the German correspondent of *Industrial and Engineering Chemistry* (New York). It is probably a question of the isolation of isoprene from potatoes and their by-products and the conversion of this, by the addition of various chemicals, into a mass similar to crude rubber. This intermediate product is then converted by week-long treatment into a caoutchouc that is said to possess an even greater elasticity than the natural. The price is said to be 20 per cent. lower than the present price of natural rubber, and the daily production of the plant to date is said to amount to 1,000 kg. Further experiments must naturally be awaited before a final estimate can be made.

Swiss Calcium Carbide Industry

THE Swiss calcium carbide industry is now progressing. The war dealt the industry a severe blow with the result that, of the 16 factories which were in operation in 1917, not more than three or four were able to continue on a solvent basis. The year 1924, however, appears to have seen the industry restored to something like its former healthy condition. As against 61,310 quintals (quintal=2 cwt.) in 1923, the export figure for 1924 was 151,048 quintals, and 1925 appears to be recording even further progress. In the first six months of this year the value of the carbide exported was 1,390,600 francs as compared with 1,100,000 for the same period in 1924. Swiss factories, while not yet working to capacity production, are hopeful of the future.

Progress of the Nitrogen Industry in 1925

By Edward B. Maxted, D.Sc.(Lond.), Ph.D.

In reviewing the developments in the nitrogen industry during the past year, one is struck by the prominence which has been attained—and maintained—by the synthesis of ammonia. Not only have so many of the hopes of previous years been translated into actual factories producing synthetic ammonium sulphate or other salts, but also the number of papers and patents dealing with further technical progress in the synthesis, and with the determination of fundamental data, has, if anything, increased. In this country, the Billingham factory of Synthetic Ammonia and Nitrates, Ltd., has an output estimated at 130 tons of ammonium sulphate a day; and this, it is stated, is shortly to be increased considerably. In France and in other countries, including quite recently the United States, the Claude hyper-pressure system continues to make good progress, this being also true of the Casale process, which employs electrolytic hydrogen and pressures intermediate between those of Claude and those at which processes of the original Haber type are operated. These factories are, of course, additional to those in Germany, in which the production of synthetic ammonia appears to have attained a state of very high efficiency.

It is probably premature, or even fallacious, to see in these movements the death-knell of the arc and of the cyanamide methods of fixing nitrogen. Special geographical or other conditions will in certain localities favour the manufacture of carbide or the use of one of the types of arc process; but the argument of cheap power can also be applied to the generation of electrolytic hydrogen for the direct synthesis of ammonia. One point stands clear: the technique of using high pressures on the largest scale has become systematised to the stage of every-day routine; and, with this, many new processes, other than that to which high pressures were first applied, become possible industrially. An example of this is the recent large-scale synthesis of methyl alcohol.

Turning to other branches of the nitrogen industry, less attention has been paid to the formation of cyanide by the Bucher method; producers of natural nitrates are adopting to an increasing degree improved methods of extraction, particularly in the treatment of less rich caliche ores; and, finally, neutral gasworks sulphate is rapidly becoming the rule rather than the exception. Some of the more important papers and patents published during the year are noted below.

Synthesis of Ammonia

The subject divides itself naturally into four parts: the preparation and purification of the gases, the manufacture of catalyst, methods of recovering the ammonia formed, and details of plant. By reason of the present relatively high price of coke, electrolytic hydrogen can, under favourable conditions, be used in place of that manufactured from water gas. This is the case, as already mentioned, in the Casale plants. Little purification is necessary, save the removal of water vapour and of traces of oxygen, both of which act inhibitively. When working with hydrogen manufactured from fuel, carbon monoxide and sulphur compounds must be removed in addition. Synthetic Ammonia and Nitrates, Ltd., Slade and Parkes propose to purify and dry the gases by adding a small proportion of ammonia, for instance, 0·1 per cent., following which the gas is cooled strongly (Brit. Pat. 240,350, THE CHEMICAL AGE, Vol. XIII, p. 453). Under suitable conditions, a liquid may be obtained, by virtue of the ammonia present, in place of solid ice, which would tend to choke the tubes of the drier. The bulk of the ammonia added remains in the dried gases, which, it is stated, may after this cooling contain as low as one volume of water vapour per hundred thousand volumes of gas. Any necessary scrubbing with cuprous ammonium carbonate, caustic soda, or with other liquid absorbents is, as would be expected, preferably carried out under the pressure used for the synthesis (Synthetic Ammonia and Nitrates, Ltd., and Dely, Brit. Pats. 222,137 and 220,651). Special means have also been devised for working continuously and for avoiding losses of ammonia in the regeneration of the saturated cuprous salts. Preliminary purification by the action of ammonia itself appears to be coming into favour. Thus, Casale (Brit. Pat. 231,417, THE CHEMICAL AGE, Vol. XII, p. 563) treats the gases with gaseous ammonia in excess of that required to combine with the hydrogen sulphide present, while de Jahn (Brit. Pat. 251,789) recommends scrubbing with liquid ammonia, preferably under the pressure employed for the synthesis. De Jahn states that for gases purified by this method further purification is usually unnecessary. These processes are in place of, or in addition to, the methods of purification, for instance, by the hydrogenation of carbon monoxide to methane, described in previous annual reviews.

Two further points may be considered briefly here. In the first place, if hydrogen is made by electrolysis, the disposal of the oxygen simultaneously produced always presents a serious problem. Casale (Brit. Pat. 233,040, THE CHEMICAL AGE, Vol. XII, p. 562) uses this oxygen for the gasification of fuel in a continuous water-gas plant, the fuel gas produced being used for raising steam for the supply of electrical energy. In the second place, the solubility of compressed nitrogen and hydrogen in liquid ammonia must have struck all who are familiar with the practical side of the synthesis. This solubility has now been measured by Larson and Black (*J. Ind. & Eng. Chem.*, 1925, 17, 715), who find that no less than 336 cu. ft. of the gas mixture are dissolved by each ton of liquid ammonia at 0° C. and at a pressure of 150 atm.

The fusion of iron or iron oxide with promoters has become a standard step in the preparation of catalysts for this reaction. In its original form, metallic iron was burned in oxygen for the removal of sulphur and other impurities; but the fusion is also utilised for the introduction of promoters such as potassium or calcium oxides. During the past year, Larson and Richardson (*J. Ind. & Eng. Chem.*, 1925, 17, 971) have given a detailed description of an electric furnace suitable for this operation. It is stated that the power consumption is a half to three-quarters kilowatt-hour per pound of iron oxide melted. These alkalis, when heated with iron, probably form a ferrite, which may to a certain extent be decomposed if the catalyst is washed before reduction to metal; indeed, Synthetic Ammonia and Nitrates, Ltd., and Collett (Brit. Pat. 237,394) definitely claim the preparation of calcium ferrite by heating iron oxide with lime in an electric furnace. It is stated that, by the formation in this way of an actual compound of the promoter with the iron, a more active catalyst is obtained than by the less intimate incorporation of the promoter by mere mixture. This, indeed, is readily understandable. In place of calcium ferrite, ferrites of barium, manganese, or magnesium are also recommended.

The original procedure in preparing iron catalyst by the high temperature method consisted in fusing the iron in oxygen by the direct action of an oxy-hydrogen blow-pipe flame. A further development consists in using the thermite method of attaining a local high temperature. This is illustrated by a patent of Casale (Brit. Pat. 227,491, THE CHEMICAL AGE, Vol. XII, p. 183), according to which the iron oxide is mixed with an alkaline earth or magnesia and with carbon, metallic aluminium or magnesium being also added. The whole is ignited in a shaft in a current of oxygen. It is stated that the temperature attained causes the iron to boil. This is reminiscent of the spongy nature of the catalyst obtained under certain conditions by heating iron by means of a blow-pipe flame, the effect being obtained either by the expulsion of absorbed gases or by the actual boiling of the iron. In contradistinction to these high temperature methods of preparing catalyst, anodic oxidation of pure iron in an alkaline carbonate solution has been suggested by the Technical Research Works, Ltd., and Lush (Brit. Pat. 241,278, THE CHEMICAL AGE, Vol. XIII, p. 527). Given iron of sufficiently pure character—which is the principal difficulty in the preparation of an iron catalyst—the method should give a surface which reduces easily and should be of good activity.

Attention may be drawn to an article of D. H. Killeffer, reprinted in THE CHEMICAL AGE (Vol. XIII, p. 192), dealing with the testing of catalysts for the synthesis of ammonia. The article, which refers especially to the methods employed by Lazote, Inc., contains many engineering and manipulative

details connected with the laboratory use of "hyper" pressures, and for this reason is of special importance.

The two standard methods of absorbing ammonia from the circuit gases continue to be separation by refrigeration and by scrubbing with water. The principal objection to the former method is the power required for cooling; but it possesses the great advantage of introducing no water vapour. Certain recent patents appear to indicate a tendency to consider once more the removal of ammonia by refrigeration. For instance, Synthetic Ammonia and Nitrates, Ltd. (Brit. Pat. 220,655), propose to reduce the power costs in this by carrying out the removal of the ammonia in stages corresponding with progressive degrees of cooling. In place of or as an addition to an extraneous cooling medium Wakeford (U.S. Pat. 1,518,421) uses the cold produced by expanding the liquid ammonia synthesised. This cooling effect can obviously be used either for the actual liquefaction of further quantities of ammonia or for cooling the gases with a view to facilitating the absorption of ammonia by water or another solvent.

If scrubbing by water is used for the removal of ammonia, this is obviously preferably carried out at the working pressure used in the synthesis. Synthetic Ammonia and Nitrates, Ltd., Slade and Gordon (Brit. Pat. 241,071; THE CHEMICAL AGE, Vol. XIII, p. 500) have described a process of absorption in which water saturated with ammonia under pressure is brought to the ordinary pressure, whereby the excess of ammonia is evolved and the normal solution of ammonia is returned to the system for the absorption of further quantities of ammonia. The velocity of absorption of ammonia in water scrubbers is of importance in all methods of ammonia production. Mathematical data dealing with this have, during the past year, been published by Kowalke, Hougen and Watson (*Chem. and Met. Eng.*, 1925, 32, 443). The effect of various packings on the efficiency was also measured.

Ammonium Salts

A certain amount of work continues to be done on the formation of ammonium salts by double decomposition. Thus, the Badische Anilin und Soda Fabrik (German Pats. 406,294, 406,202 and 406,412) describe new conditions for the manufacture of potassium nitrate and ammonium chloride from potassium chloride and ammonium nitrate. A further process involving the use of methyl alcohol is described in German Patent No. 406,413. The availability of cheap synthetic methyl alcohol thus begins to have an influence on general practice, even in the manufacture of "heavy" chemicals such as ammonium salts. In former reports mention has been made of the fixation of ammonia in forms other than its simple salts, for instance, as urea. Casale (Brit. Pat. 241,123; THE CHEMICAL AGE, Vol. XIII, p. 500) proposes to combine the synthesis of ammonia with that of urea by injecting carbon dioxide while the gases containing ammonia are still at a high temperature and pressure, for instance at 800 atm. and at 150–200° C. A catalyst such as alumina or silica is used; and it is stated that rapid formation of urea, which may be collected in a receiver, takes place.

Passing to the engineering side of the synthesis, structural details of actual large scale plants are now beginning to be published; and the publication of such details may be taken as a sign that the synthesis is now an established process to which, as far as its broad outlines are concerned, no secrecy is attached. An acceptable contribution of this nature is the paper by Ernst, Reed and Edwards (*J. Ind. and Eng. Chem.* 1925, 17, 775) which deals with a modified Haber plant along the lines of the so-called American system producing three tons of ammonia daily. Ammonia furnaces have now become considerably simplified in design; but among the earlier patent specifications published during the year, that of Greenwood and Tate (Brit. Pat. 229,354; THE CHEMICAL AGE, Vol. XII, p. 313) may be noticed. The special feature of the furnace consists in internal exchanger coils separated by tapering partitions of heat insulating material.

The formation of nitrides is closely allied to the synthesis of ammonia. Peacock (U.S. Pat. 1,521,708) has proposed to convert aluminium hydride to aluminium nitride and ammonia by treating this hydride with nitrogen at temperatures higher than 400° C. The procedure is reminiscent of early attempts to synthesise ammonia by similar methods from rare earth hydrides or nitrides by treating these with nitrogen or with hydrogen respectively. Finally, the formation of a number of nitrides by heating oxides of metals with carbon in nitrogen has been studied by Friedrich and Sittig (*Zeitschr. f. anorg. Chem.* 1925, 143, 293). Certain new rare earth nitrides were also prepared.

Nitric Acid and Nitrates

It will be remembered that, in previous reports, reference has been made to the work of Perley on the oxidation of ammonia in the presence of platinum gauze. Perley and Smith (*J. Ind. and Eng. Chem.*, 1925, 17, 258) have also discussed the value of the temperature of the platinum gauze as a control of the yield of oxides of nitrogen, and have shown that this is not the only controlling factor. They state that it is desirable in addition not to have a greater ammonia concentration than 11 per cent., otherwise the oxygen contained in the air is not sufficient for a satisfactory reaction. The gases should, moreover, preferably be preheated to 450–500° C. Decarrière, in continuing his work on the activity of palladium for the oxidation of ammonia, finds that alloys of platinum with small quantities (0·5 to 5 per cent.) of palladium allow a far higher ammonia concentration to be employed than is the case for platinum alone (*Bull. Soc. Chim.*, 1925, 37, 412). Rhodium black, supported on pumice, is also an active catalyst for the preparation of oxides of nitrogen by oxidising ammonia either with oxygen itself or with air; indeed, it is stated that under suitable conditions a practically theoretical yield of nitrogen peroxide can be obtained (Brit. Pat. 237,762; THE CHEMICAL AGE, Vol. XIII, p. 255). In carrying out the oxidation with oxygen, explosions are liable to occur. The Badische Anilin und Soda Fabrik (Brit. Pat. 241,135; THE CHEMICAL AGE, Vol. XIII, p. 500) describe a method of carrying out this process with oxygen in such a way that the risks of explosion are eliminated by the gradual addition of the ammonia.

The manufacture of nitric oxide by preheating a fuel gas and air separately to a high temperature prior to their combination has been described by Pintsch (Brit. Pat. 225,263; THE CHEMICAL AGE, Vol. XII, p. 12). The products of combustion are cooled quickly by means of a tubular boiler, and the employment of catalysts or of pure oxygen is stated to be unnecessary.

Reference may be made to several patents dealing with the condensation of oxides of nitrogen either as nitric acid or as liquid nitrogen peroxide. Thus the use of a solution of trisodium phosphate for the absorption of nitrous gases is described in British Patent No. 234,078 (THE CHEMICAL AGE, Vol. XIII, p. 108). The oxides of nitrogen may be re-liberated in a concentrated condition by treating the saturated absorbent with hot nitrous gases direct, for instance, from an arc plant.

The collection of oxides of nitrogen in the form of liquid nitrogen peroxide obviously presents certain advantages over the more usual method of collecting these in water, particularly since nitric acid of any desired strength can readily be prepared from this liquid peroxide by the enrichment method. In this connection, the figures of Ray (*J. of Phys. Chem.*, 1925, 29, 74) for the absorption of nitrogen peroxide by silica gel are interesting. Silica gel affords a promising method of absorbing nitrogen oxides, particularly when, by reason of their low concentration, they cannot readily be liquefied in other ways. The use of silica gel for this purpose is also discussed in Brit. Pat. No. 211,845.

Work on the ever important problem of concentrating and recovering nitric acid from waste nitration acid, has also been carried out, and two patents (Nobel's Explosives Company, McDavid and Williams, Brit. Pat. 237,937; Seisberg, U.S. Pat. 1,546,910) published during the past year, may be mentioned specially. Attention may also be drawn to the possibility of using metallic nitrates in the presence of a dehydrating agent for nitration purposes (Menke, Brit. Pat. 236,698; THE CHEMICAL AGE, Vol. XIII, p. 108). As an example of the method, aniline is added to a mixture of copper nitrate and acetic anhydride, the temperature being maintained at 30–36° C. The produce is *o*-nitracetic anilide.

Production of Cyanides

Reports of the Bucher or similar processes in actual works practice are always interesting; and the description by Chickering (*Chem. and Met. Eng.*, 1924, 31, p. 967) of a plant operated by the du Pont Co. may, for this reason, be noted. Soda-pulp mill "black liquor" is used as the raw material containing the necessary soda and carbon; the catalyst consists of a mixture of iron oxide with sodium fluoride, and the nitrogen is obtained from producer gas. Gas-fired

retorts, about a yard in diameter by 4 yards high, are employed. The conversion to cyanide requires about 13 hours at 975° C., the producer gas being passed through these retorts at an excess pressure of about 1 atm. A further variation of the Bucher process has been studied by Hara and Miura (*Tech. Rep. Tohoku*, 1925, 4, 191; ex *J. Soc. Chem. Ind.*, 1925, 44, 497B). Sodium chloride or sulphate, barium carbonate and carbon, together with iron as a catalyst, were heated to 1000° C. in a current of nitrogen. A yield of 85 per cent. of sodium cyanide and 5 per cent. of sodium cyanamide was obtained, and it was found that the relative proportions of the reactants has a marked effect on the yield. The mechanism of the cyanide process has been studied by Guernsey and Sherman (*J. Amer. Chem. Soc.*, 1925, 47, 1922). The principal reaction appears to be the formation of sodium, which passes successively into sodium carbide and sodium cyanide; indeed, this appears to be the only reaction which is catalysed by the iron present. Berl and Brauner (*Fortschr. d. Chem.*, 1925, 18, 1; ex *J. Soc. Chem. Ind.*, 1925, 44, 353B) have also found that considerable quantities of sodium are produced in the Bucher process, particularly if the nitrogen is supplied rapidly.

In previous reports, various methods for the conversion of cyanamides into cyanides have been discussed. This reaction may be carried out at as low a temperature as 500° C., and with almost a theoretical yield, by mixing an alkaline earth cyanamide with an alkaline earth carbide and an alkali carbonate (Brit. Pat. 225,160; THE CHEMICAL AGE, Vol. XII, p. 36). In an example given, 17·8 parts of dry calcium cyanamide, 13 parts of dry soda, and 18·5 parts of crude (70 per cent.) calcium carbide were heated to 550° C., and allowed to cool without special precautions. The product contained 28·8 per cent. of cyanide.

Attention has been paid during the year to the synthesis of hydrocyanic acid from carbon monoxide and ammonia. According to the process described in British Patent No. 223,918 (THE CHEMICAL AGE, Vol. XII, p. 13) a suitable catalyst consists of a mixture of iron oxide with an alkali, with an alkaline earth oxide, or with alumina. The reaction is carried out under pressure. Hydrocyanic acid or ammonium cyanide is also prepared by passing formamide or ammonium formate, together with a diluting gas, over a dehydrating catalyst, such as manganese carbonate on granulated bauxite reduced with hydrogen at 300–360° C. The yield is about 85 per cent. of the theoretical (Badische Anilin und Soda Fabrik, Brit. Pat. 233,080; THE CHEMICAL AGE, Vol. XII, p. 562.) The manufacture of hydrocyanic acid from ammonia and carbon monoxide has also been investigated by Bredig and Elod (Brit. Pats. 229,774 and 229,775; THE CHEMICAL AGE, Vol. XII, p. 337.) The catalyst used consists of ceria and alumina, at 500–600° C. It is advantageous to use nitrogen or hydrogen as a protecting gas; and the yield of hydrocyanic acid is again almost quantitative. Yet another method of synthesis consists in the injection of a mixture of hydrogen, nitrogen, and a hydrocarbon into an arc furnace (Brit. Pat. 235,181; THE CHEMICAL AGE, Vol. XIII, p. 158.) As is usual in this method, the gases should be rapidly cooled after leaving the arc, for instance, by passage through a tubular boiler.

Finally, one or two specifications dealing with safety measures in handling cyanides may be noted. According to a patent of Bichowsky and Harthan (Brit. Pat. 226,699; THE CHEMICAL AGE, Vol. XII, p. 115) hydrocyanic acid is produced from sodium cyanide by the action of moist carbon dioxide under reduced pressure. Silica gel or active carbon may also be used as an absorbent for anhydrous hydrocyanic acid, in order to make more convenient the handling and transport of this highly poisonous body.

In a short review of the above nature, it is impossible to notice every paper on the nitrogen industry which has been published during the past year; but an effort has been made to include papers which illustrate the general trend of work and thought in this branch. There has certainly been no lack of enterprise in the development of the newer processes described; and the tendency, particularly with synthetic ammonia, seems to be towards a considerably greater production than has been attained by plants now in operation. In many respects, the technology of the nitrogen industry has completely changed during the past fifteen years, and practically the whole of the advances made in manufacture are due directly to pure physical chemistry.

Dyestuff Progress and Problems in 1925

By Dr. E. F. Armstrong, F.R.S.

(Managing Director of the British Dyestuffs Corporation.)

THE importance of dates lies in their relation to other dates. The present year brings to a close the first quarter of the twentieth century, and throws the mind back not only to 1900 but to 1825, when Michael Faraday isolated and identified benzene, the compound which made aniline available cheaply and in abundance, and so led to the synthetic dyestuffs industry.

It was another Englishman, C. B. Mansfield, who first isolated benzene in large quantities from coal tar, and it was yet another Englishman, W. H. Perkin, who, seventy years ago, made the first artificial colour from aniline.

It is no mere desire to praise the past which leads one to revive the memory of these purely English origins of an industry whose decadence in the land of its birth has led to so many sighs and so much head-shaking. It is rather a desire to show by reference to the state of the industry to-day that Faraday, Mansfield, and Perkin have had and still have successors in their lineage and that the original source of discovery has never dried up.

Seven Years' Achievement

One hundred years since benzene was isolated! Some 70 years since it became available in quantity and since the first dyestuff was synthesised! Against this set the period of seven years since the war ended and chemists were freed to put all their energy into the task of overtaking a competitor who, with great skill and untiring patience, had reared a magnificent structure on our English foundations.

Truly, seven years is a very short period in which to convert a 90 per cent. import trade into a national industry, capable of meeting the demands of its great colour-consuming industries.

It is probably a healthy state of things that criticism achieves so readily a wide publicity, but it is less healthy when criticism is uninformed and so obscures real achievement and makes difficult the public recognition of great performance.

For it is an achievement to have succeeded, at the end of seven years, in meeting 80 per cent. of the colour needs of the country with home products equal in quality to those formerly imported. Ranges have been developed and each year has shown a striking improvement in the quality. In prices, a reduction of 50 per cent. on the average has been effected between 1921 and 1925, and the prices are still falling as efficiency increases.

It is true that there is a Dyestuffs Act, but there is machinery to protect users and to provide for the importation of such dyestuffs as are necessary but are not made in the country, or made at too high a cost.

A dispassionate and understanding examination of the colours licensed for import reveals some genuine needs which manufacturers are striving to meet. It also reveals the importance which some minor detail of shade or dyeing property can assume when money sharpens wits.

It is doubtful whether even to-day the user of colour and the chemist himself outside the industry realise the time, the effort, the knowledge, and the expenditure involved in placing on the market a new colour, whether it be one entirely new or one never made before in this country. In the first case, you have scores, sometimes hundreds, of experiments based on a new idea. Searching tests reveal that one or two of these are worth pursuing, when more research is required to evolve the best methods of preparation of each constituent and of the final product. Then the laboratory results pass through

half-scale trials to the full stature of works operations—often requiring new plant, which can only be tuned to smooth running by many trials and failures.

Even if the constitution of a colour be known and a recipe available, no short cut to production is at hand. For a recipe may be a handicap in its inaccuracies, and, even if perfect, no recipe can convey the technique of hand which only becomes second nature at the price of a long patience.

The Demand of To-day

In general the demand to-day is increasingly for dyes fast to light and fast to washing, and this is being met by an increasing production of vat colours. The tendencies can be grouped under some six heads :—

(*a*) The application of old colours to old fibres, for which they were not specially adapted. The application of vat dyes to wool is a problem which is being solved in part by home research.

(*b*) The simplification of dyeing processes by solubilising or making readily available in other ways insoluble or nearly insoluble dyestuffs. Here again the industry is playing its part.

(*c*) The application of old colours to new fibres, such as acetyl silk.

(*d*) The discovery of new colours for new fibres, such as acetyl silk.

(*e*) The evolution of new dyeing processes for novelty fabrics of mixed fibre.

(*f*) The constant replacement, by superior products, of older dyestuffs with some inherent weakness.

With regard to (*c*) and (*d*), it may fairly be claimed that the bulk of the progress made is due to British effort, and it serves to show how successful we can be when we start equally with our competitors. It is some 40 years since the first really workable artificial silk fibre was made, and it is only now that this industry is attaining a world-wide development.

To conclude as I began, the progress achieved by the British Dyestuff Industry in the short space of seven years is of good omen for its ultimate establishment, not only as fit to render efficient service to the textile industries but, by virtue of its resources in trained chemists and in plant, able to take its place in the new fields of synthetic organic chemistry which research is daily opening for fruitful cultivation.

British Chemical Industry: Developments in 1925

By W. J. U. Woolcock, C.B.E.

(*General Manager of the Association of British Chemical Manufacturers.*)

THE outstanding feature of the year just passing is the development of the feeling that we have at last reached the rock bottom of the post-war slump in industry. There appears to be good ground for this. Once or twice before in that period hopes have run high that the worst had been reached, but they proved to be too optimistic. Everything now depends on the industrialists themselves.

One extremely hopeful feature is the decline of the cry that wages must come down to lessen the cost of production. This is an example of profound (but mistaken) psychology, which has probably done more to maintain the depression than any other single factor. The cry should have been "Your wages can go up if you produce more in the same time."

In chemical industry labour troubles have been reduced to a minimum and the withdrawal by the employers of a demand for reduced wages on the workpeople agreeing to use their utmost efforts to promote efficiency is a gesture which may have very beneficial results.

Progress in Spite of Difficulties

The general trend of prices continues in a downward direction, and very strenuous efforts have been made to secure and maintain business even at rather unremunerative prices.

This fierce competition necessarily makes development difficulty: very little money is left for research. What money is available is spent on "tactical" rather than on "strategical" research. Attention has to be concentrated on the improvement of processes and efficiency of yields, and the pioneer research, which has to face an enormous number of unremunerative experiments before the great discovery is made, has naturally been handicapped.

Notwithstanding this, great progress has been made on severely individualistic and typically British lines. The newer industries, just like the old ones, are very dependent on chemical industry: indeed, in the modern trend of industrial events they are little different from the recognised branches of chemical industry. The manufacture of artificial silk, for example, proceeds apace in Great Britain.

The cultivation of beet root and the manufacture of beet sugar have made notworthy strides. Both of these new industries are of the essence of chemical manufacture, and while on this point the development of the industry founded on synthetic resins should not be forgotten.

Dyestuffs and Fine Chemicals

Working backwards from the new industries to the old, the Dyestuffs and Fine Chemical industries merit attention, for the year has been of great importance to both of them. There has been no great difference in the total amount of dyestuffs which have been manufactured in this country, and the proportion of home manufactured to imported has also remained fairly constant. Here, again, prices have been forced down, and a number of the manufacturing concerns have had difficulties in maintaining their position. The reconstruction of the British Dyestuffs Corporation is proceeding.

The sister industry of Fine Chemicals also presents a very interesting position. Each industry has been "protected," but by different methods. Each industry has had four years of such "protection." In the case of dyestuffs, with very few exceptions, only the dyestuffs which are not being made here are being imported. The fine chemicals which are being imported are, speaking generally, being made here as well, but the tariff is not sufficiently high to prevent their being dumped. The progress which has been made is, therefore, all the more remarkable.

A few figures will illustrate this. Taking the fine chemicals which are recognised as such under the Safeguarding of Industries Act, and there are many others, we find that 70,000 cwts. were made here in 1913, but 215,000 cwts. in 1924 and probably rather more in 1925. Of this amount twice as much is being exported to-day as pre-war. More than 1,000 fine chemicals, which were not made in this country before the war, are being made here to-day. No one now queries the quality of the British production. The industry is, therefore, well on the way to becoming established.

Of the older chemical industries there is little new to be said. Alkali, soap, tar and pitch all hold their own; sulphuric acid, and what may be regarded as the acid in its fixed form—superphosphate and sulphate of ammonia—are having their difficulties. Looking at the industry as a whole, however, and not at the separate constituent industries, while it cannot be said to be flourishing, it is not in an unhealthy condition. A revival in general trade would find it ready and capable to undertake its share.

United States Shale Oil Contract

THE Bethlehem Shipbuilding Corporation has closed a contract with the N.T.U. Company calling for the construction, at a cost of four hundred thousand dollars, of a plant near Santa Maria, California, capable of extracting one thousand barrels of oil per day from oil shale rock. The erection of this plant represents a development of the N.T.U. process of obtaining oil from shale, and is the first large shale extracting plant to be built in the United States. Our readers may recall an article published some time ago in THE CHEMICAL AGE describing the remarkable deposits at Santa Maria, and giving views of the plant then in operation.

A Review of the Heavy Chemical Industry in 1925

By P. Parrish, A.I.C., M.I.Chem.E.

FOR several years now the writer has reviewed the position of the heavy chemical industry in THE CHEMICAL AGE, and each year he has asked himself the question: Shall the review merely consist of a plain unvarnished record of the activities and events of the industry, commercial and technical, or shall a personal interpretation be given to them? The former treatment scarcely ever affords attractive reading, whereas a certain interest may possibly be aroused and some degree of importance added if the latter theory is judiciously followed.

Interrelation of the Various Heavy Chemical Activities

No satisfactory perspective of the heavy chemical industry can be formed in the absence of a correct appreciation of the interrelation and interdependence of one industry and another.

Sulphuric Acid.—The sulphuric acid industry is dependent largely on the coal-carbonising and coking industries. When there is a lull in the activities of the last-named, as has been the case during the last twelve months, naturally the sulphuric acid industry suffers. Similarly, a large proportion of the sulphuric acid manufactured in this country is normally absorbed by the calcium superphosphate industry. As is known, trade in this product has not been nearly so brisk as in former years, and in consequence the sulphuric acid industry has been adversely affected. Plants have only operated at about 50 to 60 per cent. of their normal capacity. What this means in the matter of production costs need hardly be urged. No wonder one hears an occasional murmur concerning the price of acid. If an 80-90 per cent. load factor could be reached, acid prices could be reduced, and a ray of hope would at long last permeate the sulphate of ammonia industry, and give encouragement to the smaller makers.

By-product Sulphate of Ammonia.—As it is, few works manufacturing less than 750 tons of ammonium sulphate per year can operate profitably. But this is not all! Throughout the year the by-product ammonium sulphate industry has been obsessed with the problem of disposing of its spent effluent liquor. True, the difficulty has not been so acute at some works as at others, but nevertheless, it is known that several undertakings have been compelled to suspend manufacturing operations, and dispose of the gas liquor as best they could.

Moreover, the existence of a vigorous synthetic ammonium sulphate industry cannot but influence the position of the by-product industry. Small wonder, therefore, that we find consideration being given to the technique of the treatment of crude coal gas (1), not only with a view to the production of a less toxic gas liquor, but also in the hope of obtaining a more concentrated product, thus reducing production costs.

The costs of steam and of sulphuric acid are the two principal items in the manufacturing cost of sulphate of ammonia. By producing a more concentrated gas liquor, the former item can be reduced appreciably. Pending a reduction of acid prices, naturally, consideration will turn to possible substitutes. Already, the advantages (2) of anhydrous calcium sulphate in lieu of sulphuric acid have been urged. If the so-called gypsum process can be considered an important factor in lowering production costs of the synthetic material (3), surely the by-product industry must apply itself to the adaptation of the process, and render it available for its particular product.

For similar reasons, it is found that prominence has been given to another process (4), relating to the production of sulphate of ammonia without the use of sulphuric acid. This process has reference to B.P. 215,470 (5), which provides for ammonia and water vapours being brought together in a reaction chamber with a gaseous mixture comprising sulphur dioxide and air, a reaction temperature of just below 100° C. being maintained. The concentration of sulphur dioxide is about 4 per cent. of the total volume of gas.

The distinctive feature of the process is that ammonium sulphite is produced in a highly reactive physical condition, which rapidly oxidises in the presence of air to ammonium sulphate, with a rise of temperature.

This is not the only process involving the intermediate production of ammonium sulphite, which can be applied successfully in the manufacture of ammonium sulphate. Other processes known to involve a different oxidising medium have operated in the past, and are still available.

As regards the effluent problem: what appears to be required is a process (6) of fractional condensation—one aiming at the removal of the tar-forming constituents prior to the formation of the virgin gas liquor.

Throughout the year discussions relating to the physical and mechanical conditions of sulphate of ammonia have taken place. It has been indicated that buyers have a preference for neutral sulphate of ammonia, composed of distinct crystals. Crystal size (7, 8) has been tentatively defined, and valuable hints bearing on saturator conditions in relation to crystal size have been given. A paper meriting careful study was contributed by A. D. Cummings, B.Sc. (9), on the mechanical condition of sulphate of ammonia.

The conclusions reached as regards grade of sulphate, crystal size, colour, moisture, and caking, are sound, and will, in almost all cases, bear careful scrutiny. That caking can be reduced very materially is not doubted. More complete drying of the salt is necessary. Few works dry below 0·1 per cent. of moisture. The last-named limit is too high. On the other hand, greater care must be given to the conditions under which sulphate of ammonia is stored. An artificial temperature must be maintained, and this must certainly be above dew-point. And yet there is another stage before ideal conditions can be deemed to have been reached. Suitable bags must be used.

The Superphosphate Industry

Calcium Superphosphate.—Competition in this industry has been acute. Many works have been unable to conduct manufacturing operations profitably. During the year application for assistance under the Safeguarding of Industries Act was made. The application was unsuccessful. A friendly criticism (10) of the superphosphate industry has been made, and constructive suggestions for improvement have been offered. It has been indicated that mass production, combined with cheap transit charges, will undoubtedly be the salvation of the superphosphate industry. An interesting article (11) bearing on mass production, which contrasts British and other methods, merits careful consideration. But it is disquieting to find that works are being closed, and prominent leaders (12) actively engaged in the fertiliser industry are holding out small hope of recovery. That the outlook during the next few months may substantially improve is fervently to be hoped.

Spelter.—How far the superphosphate industry is likely to benefit from the operations of the spelter industry it is impossible yet to say. Sir Robert Horne, (13) Chairman of the National Smelting Co., Ltd., has declared that the policy of his company is to undertake smelting operations on the largest scale compatible with supplies of raw material. Although their production of sulphuric acid up to the present has been sold to the National Sulphuric Acid Association, it is understood that the possibility of using acid in conjunction with other manufacturers in other industries is being investigated. The strong position of Belgium in the matter of superphosphate manufacture is attributed to the availability of cheap zinc

(1) (*a*) Chief Alk. Inspector's Report, CHEMICAL AGE, Vol. XIII, p. 6; (*b*) Dr. T. Lewis Bailey, *Gas World*, Vol. LXXXIII, p. 48; (*c*) Dr. Smith and T. Campbell Findlayson, M.Sc., *ibid*, Vol. LXXXIII, p. 472.
(2) CHEMICAL AGE, Vol. XIII, pp. 28 and 465.
(3) *Chem. and Met.*, Vol. 32, June, 1925, p. 567.
(4) *Gas World*, Vol. LXXXIII, p. 474.
(5) B.P., Jaques, West and Morgan.
(6) CHEMICAL AGE, Vol. XIII, p. 592.
(7) *Ibid*, Vol. XI, p. 640.
(8) *Ibid*, Vol. XII, p. 290.
(9) *Gas World*, Vol. LXXXIII, p. 470.
(10) CHEMICAL AGE, Vol. XIII, p. 272.
(11) *Ibid*, Vol. XIII, p. 351.
(12) *Ibid*, Vol. XIII, p. 349.
(13) Report of Annual Meeting—National Smelting Co., Ltd.

blende acid. It is to be hoped that renewed vigour may be given to the British superphosphate industry by reason of cheap supplies of acid from the treatment of zinc concentrates. So much for the dark side of the picture; now let us examine the brighter and more hopeful side.

Greater Alkali Exports

Alkali.—The steady growth in exports of caustic soda is one of the encouraging features of British overseas trade in heavy chemicals during recent years. The total exports of British manufactured caustic soda in 1924 amounted to 88,150 tons, as contrasted with 77,971 tons in 1923, and 74,907 tons in 1913. The future is full of hope.

The rapid development of the artificial silk industry (viscose process) is creating an increasing demand for caustic soda in Italy. Although that country possesses many important electrolytic caustic soda plants, it is believed that the inability to dispose of the resulting chlorine constitutes a hindrance to the extension of that industry. The importance of finding additional markets for chlorine has been emphasised in previous annual reviews.

The Argentine also offers a rapidly growing market for caustic soda and soda ash. Similarly, the requirements of China and Japan have increased.

Despite the fact that the alkali industry (14) is undergoing a slow metamorphosis, this country is fortunate in having well-established and highly-efficient ammonia-soda works. Of interest in this connection are the observations made by Mr. E. N. Allen, President of the Mathieson Alkali Works, Inc., of New York City (15). He remarks that few industries require such an enormous amount of invested capital per ton of output as does the ammonia-soda process. Returns on capital alone depend on the sale of large tonnages, and records show that every fifteen years an ammonia-soda plant has to be rebuilt.

A new works, erected by Brunner, Mond and Co., Ltd., at Wallerscote, will shortly be starting operations. This works (16) is said to embody every improvement of every works in the world, where the Solvay process is in operation.

The New Magadi Soda Co. (17) has now the advantage of the co-operation in this country and abroad of the whole organisation of Brunner, Mond and Co., Ltd. Profitable working is anticipated by 1928.

Potash.—One must refer to the financial sensation (18) of the year—viz., the successful flotation in this country by the Potash Syndicate, of Germany, of an issue of £5,000,000 7 per cent. bonds. The rapidity with which subscriptions amounting to £60,000,000 were received is little short of remarkable. Despite the growth in the production of synthetic ammonia, the position of potash remains practically unchallenged. Potash must ever be one of the principal constituents of any compound fertiliser. Following the close of the war there was an active movement to develop the trade in French potash obtained from the mines in Alsace-Lorraine. It is understood that the potash industries in these two countries—France and Germany—have now agreed upon terms upon which the world's requirements outside these countries are to be supplied.

Synthetic Ammonia.—The achievements at Billingham (19) constitute very encouraging reading. The 30-ton plant which the company ultimately increased to 50 tons capacity is running smoothly, and is already showing profits. With the aid of a trade facilities guarantee of £2,000,000 and further expenditure by the company, the output is to be increased to 200 tons of ammonia per day. As 1 ton of ammonia represents 3·8 tons of ammonium sulphate, the total production will represent 760 tons of sulphate per day. It is not intended to convert the whole of the ammonia into sulphate, but other ammonium compounds will be made, according to the requirements of the market. The company's experts are so satisfied with the plant and process that they have reachep the conclusion that no alternative method, whether Claude, Häusser, or Casale, offers any advantages over the Brunner-Mond process, which has been developed on the lines of the original Haber process. The more one learns about the Billingham enterprise, the more impressive its success becomes from both the chemical and engineering points of view. It is, indeed, an achievement of the first order. Coupled with the encouraging improvement in the alkali industry, already referred to, it constitutes the bright side of the picture. Are still further technical improvements in the Brunner-Mond process to be anticipated?

Reference to B.P. 237,394 (20) shows that consideration is being given to catalysts, the use of which will avoid very high pressures. Calcium ferrite is preferred, and is obtained by heating a mixture of calcium oxide and iron oxide in an electric furnace. The product is crushed for use as a catalyst, and the synthesis is effected by a temperature of 500° C., and at a pressure of 90 atmospheres. Other ferrites and ferrates which are not active contact poisons can be used. This development must be read in conjunction with that adumbrated by the *Deutsche Bergwerks Zeitung*, relating to the Mont Cenis process (21), where working pressures of less than 100 atmospheres, and temperatures not exceeding 400° C. are spoken of. Although nothing definite has been divulged, it is stated that the basis of the last-named process is an exceedingly potent catalyst. Probably the two companies have still another unexpected achievement to reveal. That further information will be awaited with interest goes without saying.

Beyond what has been mentioned, there is nothing really outstanding in the technical records and patents of the year, but in order that easy reference can be made to such as would warrant comment, if space allowed, a list has been compiled, and is subjoined.

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(14) Chemical Age, Vol. XII, p. 295.
(15) *Chem. & Met.* (Review Number). January, 1925.
(16) Chemical Age, Vol. XII, p. 295.
(17) Chemical Age, Vol. XII, p. 430.
(18) *Ibid*, Vol. XIII, p. 389.
(19) *Ibid*, Vol. XII, p. 528.
(20) Chemical Age, Vol. XIII, p. 230, Synthetic Ammonia and Nitrates, Ltd.
(21) *Ibid*, Vol. XIII, p. 521.

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Some Chemical Inventions of 1925

By Our Patents Correspondent

The close of the year again brings an opportunity to review the progress of the chemical industry as represented by the patented inventions. These have been as numerous as in past years and cover every branch of the industry, and a few of them, selected from the point of view of the principles involved in them, or the results claimed for them, are now briefly referred to.

Synthesis of Ammonia

Probably no subject has received more attention from inventors during the past year than that of synthetic ammonia, particularly the investigation of further suitable catalysts, the reduction of the pressure necessary for the reaction, and the more economical working of the process. Thus in one case a catalyst is formed from an artificial or natural oxide of iron, cobalt, nickel, manganese, chromium, molybdenum, tungsten or uranium, by heating with a substance having a high combination heat with oxygen, and which is not a catalytic poison, such as carbon, magnesium, aluminium, or calcium. Another catalyst which avoids the use of very high pressures consists of calcium ferrite; synthesis can be effected at 500° C. and at 90 atmospheres pressure. According to another process for obtaining hydrogen or nitrogen-hydrogen mixtures, hydrocarbons are vaporised and burned with sufficient oxygen to convert the carbon to carbon monoxide only, preferably in the presence of a refractory material containing iron or nickel, to make the reaction more complete. The gases are then treated with steam in the presence of iron oxide to convert the carbon monoxide into dioxide, which is removed, leaving hydrogen. If air is used for burning the hydrocarbon, a nitrogen-hydrogen mixture is obtained. In another process, which avoids any risk of the presence of carbon monoxide or dioxide in the reaction gases, mercury vapour is treated with steam to obtain mercuric oxide and hydrogen. The oxide is then heated under reduced pressure to obtain oxygen and mercury, and the mercury used again.

Another invention employs the combustion products of coal or coke oven gas with a slight excess of air, the gases being treated with hydrogen at a high temperature to remove excess of oxygen. The carbon dioxide is removed with ammonia, yielding ammonium carbonate which can be converted to the sulphate or urea. The remaining nitrogen is mixed with hydrogen and converted into ammonia.

Some ingenious methods have been employed in purifying the reaction mixture. Thus the carbon oxides, hydrogen sulphide, nitric oxide, and other acid compounds may be removed by adding an excess of ammonia, the residue of which is not harmful. The same reagent can be used in the removal of water vapour. If it is attempted to remove the water by cooling, the temperature must be substantially below 0° C., since the vapour pressure of water even at 0° C. is 4·5 mm. of mercury, and the formation of ice would involve the possible blocking of the pipes. If a small proportion of ammonia is added, however, even 0·1 per cent., the condensed water contains ammonia in solution, and its freezing point is so low that it remains liquid. Nine-tenths of the added ammonia remains in the dried gases.

Methanol

A development which will probably be of far-reaching importance is the synthetic production of methanol from carbon monoxide or dioxide and hydrogen at a high temperature and pressure, and here the catalyst is the important factor in the process. In one case it has been shown that the catalyst may consist of mixtures of such oxides of metals of different groups of the periodic system as are non-reducible by carbon monoxide or dioxide up to 550° C., with excess of the more basic oxide. Thus chromium oxide with two to twelve molecular parts of zinc oxide may be used, the reaction being effected at a pressure above 50 atmospheres and temperature of 200°–600° C., yielding mainly methanol. Any catalyst soon loses efficiency if the gases are not pure, particularly if they contain organic sulphur compounds and volatile iron compounds. These can be removed by means of activated carbon.

Another somewhat similar process employs a catalyst consisting of oxides, hydroxides, or carbonates or alkali, alkaline earth or earth metals, aluminium, zirconium, thorium, cerium, or mixtures of magnesium or aluminium compounds with oxides of lead, bismuth, thallium, zinc, cadmium, copper, tin, antimony, silicon, boron, titanium; iron, cobalt, or nickel must not be present. Examples of such catalysts are potash-lime, magnesium chromate, magnesium oxide or zinc oxide and potassium or rubidium hydroxide or carbonate. The catalyst deteriorates if volatile compounds of iron, cobalt or nickel are present, particularly the carbonyls, so that the heated parts of the apparatus must be made of, or lined with, copper, silver, aluminium, or a steel containing a substantial proportion of chromium, manganese, tungsten, molybdenum, or vanadium. In another invention a catalyst, particularly suitable for treating a mixture of carbon monoxide with 9 molecular parts of hydrogen at 300° C. and 150 atmospheres pressure, is made by precipitating a solution of calcium nitrate containing 10 per cent. of zinc nitrate,

with potassium carbonate, washing and drying the precipitate, and reducing with hydrogen at 250°–300° C. In all these processes for producing methanol, the gases must be passed over the catalyst at a certain minimum speed. If the speed is less than this, higher alcohols are produced.

India Rubber

The manufacture of synthetic india rubber has not been much in evidence in the last year or two, probably owing to the former low price of natural rubber. Probably the higher prices now in force may stimulate interest in the artificial product. Most of the inventions have been concerned with the treatment of the latex to preserve it or render it suitable for direct employment for impregnating fabrics, etc., or to accelerate the vulcanisation. Thus, it has been found that rubber latex can be separated into two layers by adding a vegetable or animal colloid such as caragheen, or Iceland moss, or gelatine. One of the layers contains the greater part of the rubber, still in uncoagulated form. Several new vulcanisation accelerators have been noted, including zinc α-phenyl biguanide, obtained by heating α-phenyl biguanide with zinc oxide, and products obtained by treating disubstituted guanidines with disubstituted dithiocarbamic acid. In another process, dissolved rubber is vulcanised by the interaction of hydrogen sulphide and sulphur dioxide gases upon it, in the presence of 1:2-naphthoquinone or toluquinone. An interesting process has been patented by which a turpentine substitute can be obtained by the distillation of vulcanised rubber, either dry or in solution.

Some Organic Products

An interesting process has been patented for the synthetic manufacture of acetic acid, acetaldehyde, and acetone, which are obtained by passing a mixture of methane and carbon dioxide or monoxide at a pressure of 12–50 atmospheres and temperature of 100°–500° C. over copper, iron, nickel, platinum, or palladium. The carbon dioxide or monoxide must be in excess. Another invention deals with the partial oxidation of polynuclear hydrocarbons such as naphthalene, anthracene, phenanthrene, or mononuclear hydrocarbons such as benzene, by means of air in the presence of vanadate of tin or bismuth as a catalyst. The catalyst is obtained by precipitating stannic chloride with ammonium vanadate. Naphthalene is converted by this process into phthalic acid, anthracene to anthraquinone, benzene to maleic acid, toluene to benzaldehyde or benzoic acid. In a similar process, *o*-, *m*-, or *p*-nitrotoluene, nitroxylene, nitronaphthalene, nitroanthracene, nitroethyl benzene, etc., are oxidised by passing the vapour mixed with air over the same catalyst, at 200°–300°C. Alcohols and aldehydes are similarly oxidised, and the method has the advantage that the products obtained are very pure. Alcohols yield the corresponding carboxylic acid and/or aldehyde or ketone, and aldehydes yield the corresponding carboxylic acid.

Considerable attention has been given to the synthetic manufacture of formaldehyde by processes somewhat similar to the manufacture of methanol. According to one patent, methane is oxidised in the presence of a catalyst consisting of an inert substance impregnated with a metal oxide or hydroxide. This is preferably effected by impregnating with a metal salt, and then treating with a precipitating agent. Thus a mixture of methane and air can be passed over pumice impregnated with iron oxide and chromium oxide, yielding 37 per cent. of formaldehyde and 4 per cent. of methyl alcohol. In another process, ethane is oxidised by passing it with air through a heated silica tube, yielding formaldehyde and some acetaldehyde, which are condensed out in an ice-cooled vessel. The remaining gas contains no benzene, diolefines or tar, and its ethylene content can be absorbed in acid. This process is applicable for treating propane or butane, or coke-oven gases. Another inventor oxidises acetylene to acetaldehyde by adding 2–20 per cent. of oxygen, and passing the gases through a solution of iron and copper sulphates containing sulphuric acid and also metallic mercury.

An interesting development of the methanol process, in which formamide can be obtained by a continuous process, has been recently published. It was known that formamide could be obtained by the action of ammonia on alkyl formates, but the reaction proceeds very slowly. If compressed ammonia, in the form of gas, liquid, or strong solution is used, the action proceeds much more rapidly, *e.g.*, the reaction between ammonia and methyl formate at 8 atmospheres pressure is complete in a few minutes. The methyl formate can be obtained by the action of carbon monoxide on methanol or by the catalytic hydrogenation of carbon oxides to methanol when methyl formate is a by-product. Methanol can be treated with carbon monoxide and ammonia in succession or simultaneously in the same vessel, preferably in the presence of an alkali metal or alcoholate. The methanol merely acts as a conveying medium. Another process for effecting the conversion of ammonium formate to formamide involves passing the vapour with ammonia over bauxite, alumina, titanium oxide, silica, iron oxide, china clay, pumice, or kieselguhr, which has been heated to a high temperature before use. A complete conversion to formamide takes place.

In several inventions an interesting process for the manufacture of hexamethylene tetramine without using very high pressures, and in a comparatively short time, is developed. The reaction between methylene chloride and liquid ammonia at a pressure of 380 lb. per square inch, and temperature of 60° C. is complete in about 50 hours if 300 per cent. excess of ammonia is used. The excess of ammonia can then be distilled off, and the hexamethylene tetramine dissolved out from the residue by chloroform or carbon tetrachloride. Ammonium chloride remains in the residue, and may be used to produce the ammonia required. The product is of high purity. The reaction velocity can be increased by the presence of water, *i.e.*, by using ammonia solution, provided that such an excess of ammonia is used that hydrochloric acid cannot form, and hexamethylene tetramine hydrochloride is not produced by hydrolysis.

An invention which should have a wide application is that in which the nitration of organic compounds is effected by means of copper or iron nitrate instead of nitric-sulphuric or nitric-acetic acid mixtures, in the presence of glacial acetic acid, acetic anhydride, acetyl halogenide, etc. The temperature can be below 60° C. so that little nitrous vapour is given off. Aniline can be nitrated in this manner to *o*-nitracetanilide. The product usually depends on the particular metal nitrate chosen, thus phenol is nitrated by ferric nitrate and glacial acetic acid to mixed dinitrophenols, while nitration with copper nitrate and acetyl chloride yields 4 : 6-dichloro-2-nitrophenol.

Pigments

A number of inventions for the production of pigments have been patented, notably those relating to white lead, iron oxide, and organic products. One inventor obtains a very voluminous white pigment by adding solid powdered lead acetate in small quantities to a 5 per cent. solution of sodium carbonate heated to boiling point, until the molecular equivalent has been added. A white pigment is also obtained in a similar manner by adding solid zinc sulphate to boiling sodium carbonate solution. In another improvement which yields a heavier white lead which does not "dust" and absorbs less oil, basic lead acetate solution is precipitated with carbon dioxide. The strength must be between 34° Bé. and 17° Bé., and the temperature at or below 0° C. Lithopone has again been the subject of considerable research with a view to improving its qualities as a pigment, especially its fastness to light. A novel method of attaining the last object involves the addition of 0·5 per cent. of a heavy metal compound, *e.g.*, of iron, copper, nickel, or cobalt. The manufacture of iron oxide pigments by the electrolytic decomposition of common salt with a soluble iron anode appears to be attracting considerable attention.

Cyanides and Cyanamides

The production of cyanides and cyanamides in the electric furnace, and their conversion into fertilisers is being developed principally in America owing to the cheaper electric power available, but a number of alternative processes are also available, such as the production of hydrogen cyanide from carbon monoxide and ammonia in the presence of iron oxide as a catalyst. The latter must be protected by the addition of alkali or alkaline earth oxides or alumina. A modified process which gives a yield of hydrogen cyanide which is nearly quantitative, employs as catalysts, oxides of the rare earths cerium, lanthanum, didymium, and oxides of thorium, titanium, molybdenum, uranium, vanadium, particularly

a mixture of cerium and aluminium oxides. Another process for converting the alkaline earth cyanamide usually obtained into cyanide involves the treatment of the cyanamide with a mixture of alkali carbonates and alkaline earth carbide. If the materials are dry, a nearly theoretical yield of cyanide can be obtained.

An interesting process in connection with cyanides is that in which formamide or ammonium formate is passed with a diluent gas at a high temperature over a catalyst capable of removing water. As diluents, nitrogen, hydrogen, carbon monoxide, water gas, producer gas, or ammonia can be used. In the last case, the product is ammonium cyanide, and in the other cases hydrogen cyanide; a yield of 85 per cent. of ammonium cyanide can be obtained. A suitable catalyst can be obtained by making a mixture of magnesium carbonate and granulated bauxite into a paste, drying, and reducing with hydrogen.

A useful method for treating alkali, and alkaline earth cyanamides is that in which they are dry-distilled with sawdust, peat, lignite, etc., to obtain ammonia, while the residue of calcium carbonate and carbon is used for the production of more cyanamide.

Fertilisers

Most of the research in connection with fertilisers has been in the subject of synthetic nitrogenous products based on synthetic ammonia, and to some extent the subject of phosphate fertilisers and mixed fertilisers. In one case, a mixed fertiliser containing nitrogen, phosphorus and potash is obtained by treating calcium phosphate rock with sulphuric acid and sulphates to obtain a mixture of neutral phosphates. No hydrofluoric acid escapes, although fluorides may be present in the calcium phosphate. After three days of this treatment, less than 1 per cent. of the phosphoric acid content remains insoluble. The product is treated with nitre cake and organic matter to obtain a mixed fertiliser which has the advantage that it has no destructive action on the bags in which it is packed. In another case natural phosphates are treated with potassium-magnesium carbonate in the presence of silicates if these are not present naturally, yielding a highly concentrated fertiliser. An interesting process for the manufacture of phosphates only, depends on the burning of powdered coal, ground mineral phosphates, and gypsum, in a furnace. An example of a mixed fertiliser, which is concentrated and very stable, comprises a mixture of potassium nitrate, urea, and ammonium phosphate.

Concentrating and Purifying Processes

Among a large number of inventions for the treatment of crude products, many of them involving improvements in plant and apparatus, may be noted one for purifying carbazol by distilling the crude carbazol in the presence of hydrocarbons or other organic solvents boiling at 200°–360° C. Carbazol distils above 200° C., and crystallises from the distillate, and by repeating the operation, carbazol of 94 per cent. purity is obtained. A suitable solvent is a gas oil of specific gravity 0·84, obtained by distilling kerosene oil with steam and removing the low boiling hydrocarbons till the specific gravity reaches 0·84, and boiling point reaches 240°–280° C. Several methods of concentrating acetic acid have been patented, including one in which the dilute acid is vaporised, heated to 150° C., and the vapour treated with solvents which are not miscible with water, such as phenols other than carbolic acid, creosotes, and liquid fatty acids boiling above 150° C. The solution is then distilled in vacuo to recover the acetic acid.

In a process for concentrating dilute nitrous gases, the gases are absorbed by passing them through a tower in contact with saturated trisodium phosphate solution, and the solution then neutralised and evaporated. The concentrated liquor is decomposed by hot nitrous gases from an electric arc, liberating concentrated nitrous gases which can be dissolved in water.

General

There is still a considerable amount of research devoted to adsorbent substances, particularly active carbon, silica gel, and bauxite, the improvements being mainly in details of manufacture. Thus, the efficiency of bauxite as a filtering medium in the purification of oils has been found to be proportional to the percentage of moisture in the raw material. When bauxite has been dehydrated at 400° C. and allowed to cool, it will evolve heat when moistened with kerosene or water, the quantity of heat being proportional to the moisture in the raw material. The efficiency of bauxite as a desulphuriser is proportional to the heat evolved when it is moistened with the oil to be treated, so that a simple preliminary test of a given sample of bauxite on the above lines will enable its efficiency to be determined. A roasting temperature of 400° C. is best when used as a decolorising medium, and 600° C. as a desulphurising medium. Much attention, too, has been devoted to the production of exceptionally light, highly absorbent active carbon, and to its treatment with various reagents to improve its qualities.

Several patents relate to the construction of acid-resisting apparatus. Concrete is rendered acid-resisting by treating with molten sulphur and kieselguhr, and tanks can be lined with indiarubber by coating with a rubber mixture, and then introducing a hot liquid to vulcanise it.

An interesting process for effecting chemical reactions is that in which an absorbent such as bone black, fuller's earth, or burnt kieselguhr is impregnated with one reagent and treated with the other. This is applicable to all kinds of reactions, notably the introduction of groups into organic compounds, sulphurising, nitrating, chlorinating, etc., to the purification of benzol, xylol, crude petroleum, cracked oils, mineral or tar oils, etc.

Inventions for the manufacture of catalysts, and the regeneration of spent catalysts, as well as the selection of new catalysts for special purposes have been numerous, and several of these have been noticed in connection with their various applications. One other example may be mentioned here, in which metal catalysts contaminated by sulphur are treated with formic acid or acetic acid vapour at 100° C. until evolution of hydrogen sulphide ceases, and the formates or acetates then decomposed by increasing the temperature to 150° C., thus regenerating the catalytic metal and recovering the acid.

In addition to the few selected inventions which have been noted above, there has been evidence of active progress in the various specialised branches of the industry, especially in dyestuffs, synthetic drugs, metallurgical chemistry and gas manufacture, but considerations of space prevent a detailed analysis of these inventions from being given.

New Dyestuffs Feature

Details of "The Chemical Age" Supplement

FOLLOWING the announcement last week of the Dyestuffs Monthly Supplement to be published as a new feature in THE CHEMICAL AGE, beginning with the New Year, details are now available of the first number, which will appear in the issue of January 9. The contents will include, in addition to the topical notes on important developments, a special article on the dyestuffs industry from the dyers' point of view, by Mr. H. Sutcliffe Smith, chairman of the Colour Users' Association. This will afford a valuable survey of the dyestuffs industry, which, following the recent reconstruction of the British Dyestuffs Corporation, in which Mr. Sutcliffe Smith took such a leading interest, will be an important pronouncement on the present position of the trade.

Among the regular features, the Dyestuffs "Who's Who" will outline the careers of the leaders of the industry, and the first issue will contain a brief biography of Colonel Sir Edward Brotherton, Bart. Another monthly item of equal popularity will be entitled "Around the Works," giving a sketch of the principal dyestuffs plants in the country. This series will begin with an illustrated account of the works of the British Dyestuffs Corporation. Market reports from our correspondents in the dyestuffs areas will be another regular feature. As stated last week, however, the reports of dyestuffs matters, in particular the abstracts of patent literature, will continue to be included as previously in the ordinary issues of THE CHEMICAL AGE, the new feature being designed to supplement this information. The subscription to THE CHEMICAL AGE, including the supplement and a *free* copy of THE CHEMICAL AGE YEAR BOOK (published separately at 10s. 6d.) is 21s. per annum, post free (abroad 26s.). The twelve monthly issues containing the Dyestuffs Supplement, may be subscribed for separately at 7s. 6d. (abroad 10s.).

Chemical Exports in 1925

Importance of Sulphate of Ammonia

EXPORTS of British chemicals during the twelve months ending with November 30 last have exceeded £20,735,000 in value. In this figure the main totals have been realised in ammonium sulphate, of which overseas' shipments were worth almost £3,313,000. Tar and creosote oils which in round numbers approached £1,273,000, painters' colours at £3,788,000, and £3,853,000 of sodium compounds. The latter thus constituted almost 19 per cent. of our total trade, whilst painters' colours represented 18·5 per cent. and ammonium sulphate 16 per cent., these three groups thus making up more than half our export business.

From the table appended the twelve months ending November, 1924 stand out as the best period of export trade during the past three years, and taking this as the base year the twelve months ending November, 1923, were 1·2 per cent. lower and the latest twelve months less by 8·1 per cent.

Nevertheless in some sections better returns have been made during 1925 than in 1924, and such examples include bleaching powder, disinfectants, anthracene, painters' colours and crude glycerine, whilst a number of other sections have maintained their individual totals fairly satisfactorily.

	Year ending November 30,		
	1923.	1924.	1925.
	£	£	£
AMMONIUM COMPOUNDS :—			
Chloride	142,752	130,248	90,769
Sulphate	4,025,691	3,719,099	3,312,745
BLEACHING POWDER	141,678	153,462	182,278
COPPER SULPHATE	1,020,182	996,020	904,302
DISINFECTANTS	924,349	1,044,858	1,061,697
DYES AND DYESTUFFS :—			
Coal tar products	975,115	972,156	869,817
Other sorts	98,054	90,103	71,127
Total	1,073,169	1,062,259	940,944
OTHER COAL TAR PRODUCTS :—			
Anthracene	3,441	1,753	7,230
Benzol and toluol	131,231	120,027	14,928
Carbolic acid	398,492	249,625	241,685
Naphtha	22,042	19,365	5,972
Naphthalene	119,065	38,103	11,217
Tar oil, creosote oil	1,646,858	1,681,498	1,272,664
Other sorts	220,968	243,678	271,913
Total	2,542,097	2,354,049	1,825,609
PAINTERS' COLOURS :—			
Ground barytes	33,663	27,907	25,514
White lead	428,598	436,058	271,183
Paints ground in oil and water	849,908	876,951	1,177,484
Paints and enamels prepared	941,857	1,189,633	1,151,073
All other sorts	1,236,804	1,160,971	1,162,683
Total	3,490,830	3,691,520	3,787,937
POTASSIUM COMPOUNDS :—			
Chromate and bi-chromate	96,542	83,798	48,773
Nitrate	33,735	37,356	25,793
Other sorts	206,633	196,057	161,892
Total	336,910	317,211	236,458
SODIUM COMPOUNDS :—			
Carbonate	1,649,876	1,632,950	1,482,428
Caustic	1,356,854	1,449,572	1,277,702
Chromate and bi-chromate	101,874	103,040	71,186
Sulphate	345,648	275,040	196,523
Other sorts	1,011,826	962,902	825,443
Total	4,466,078	4,423,504	3,853,282
Glycerine crude	175,463	150,023	214,782
Glycerine distilled	322,257	666,698	490,645
Sulphuric acid	26,029	38,654	31,190
Tartaric acid	127,219	85,698	65,545
Zinc oxide	109,771	115,594	84,956
All other chemicals	3,373,537	3,626,163	3,651,947
Total	£22,298,012	£22,575,060	£20,735,068

The Fertiliser Industry

Substantial Increase in Nitrogen Consumption

THE past year has been remarkable for a substantial increase in the consumption of all forms of nitrogen, estimated at no less than 11 per cent. The world production of by-product and synthetic sulphate of ammonia for 1924-25 was 545,100 tons compared with 506,000 tons for 1923-24. In 1913 the total consumption of nitrogen for agriculture was only about 595,000 tons, of which about 290,000 tons was supplied by Chile nitrate. Thus the demand has increased by 64 per cent. and the production of forms of nitrogen, other than Chile nitrate, by no less than 142 per cent. The home demand for sulphate of ammonia in 1924-25 accommodated 153,200 tons. The Sulphate of Ammonia Federation reported a slight increase in exports, but decreases in the figures for Holland and Belgium were balanced by marked increases in the amounts taken by France and Italy. There was a gain of 49,000 tons in Spain, but almost an equal loss in Japan. This important loss was occasioned by the tendency of the neutral sulphate to cake in transit, and a technical committee was organised to deal with this difficulty. The prices for home use this year have been, per ton :—January, £14 10s. ; February, £14 12s. ; March, April, and May, £14 14s.; June, July, and August, £12 5s. ; September, £12 7s. ; October, £12 9s. ; November, £12 11s. ; December, £12 13s., all 21·1 per cent. nitrogen, delivered in 4-ton lots.

In August, the Ministry of Agriculture and Fisheries published a report of the Fertilisers and Feedingstuffs Committee, which drew up schedules for the classification of all products and virtually paved the way for a new Fertilisers Act.

Early in the year there was a considerable scare in the Chilean nitrate interests following on reports of the growing importance of the synthetic products, but an official survey revealed that while Chilean nitrate might be hampered by production methods that left some room for improvement, the industry was still in a strong position to face competition.

Superphosphates Inquiry

After many sittings, the committee appointed by the Board of Trade to inquire into the application of the Fertiliser Manufacturers' Association for the imposition of a duty on imported phosphates, issued their report in July. A majority report, with the Chairman as the only dissentient, was against the imposition of the duties on the evidence put forward.

The Potash Industry

On December 8, within a few minutes of the opening of the lists, an issue of £5,000,000 seven per cent. bonds by the Potash Syndicate of Germany was floated. The French and German potash interests have come to an agreement with regard to distribution. The German syndicate holds the sole rights in potash production in Germany until 1953. There was a further £3,000,000 bonds offered simultaneously in Holland, Sweden, and Switzerland, all forming part of an authorised issue of 15 million. The United States interests withdrew their expected support to the loan. The position of potash remains practically unaffected by the growth of synthetic fertilisers, and the remarkable response to this recent issue indicates that the future would appear to promise equal prosperity.

Coal-Dust Explosion Risks

THE Mines Department announces that a paper on "Coal-Dust Explosions : The Effect of Release of Pressure on their Development," by H. P. Greenwald and R. V. Wheeler, has just been published. This paper is the second joint publication by the United States Bureau of Mines and the Safety in Mines Research Board, and describes work carried out at Eskmeals during the summer of 1924, when Dr. Wheeler, the director of the experimental station, had the assistance of Mr. H. P. Greenwald, assistant physicist on the Bureau of Mines staff. It is stated that the results show clearly that there is less danger of a coal-dust explosion developing from a given source of ignition at a long-wall face than at a "dead-end" or *cul-de-sac* ; and, generally, that branch roads near the point of ignition of an incipient coal-dust explosion, by affording release of pressure, retard and may prevent the development of the explosion.

Chemical and Allied Societies

Notes on Their Work During 1925

Association of British Chemical Manufacturers

The Association was again responsible for the Chemical Section of the British Empire Exhibition, which can rightly be claimed as a successful piece of propaganda for British chemistry. The Association is now organising a chemical exhibit for the British Industries Fair to be held at the White City in February. Publicity by means of cinematograph films has been continued in a large number of cinemas in this country and abroad.

The various Groups of the Association and their Committees have met frequently and have discussed matters affecting their more particular interests and those of the industry as a whole. The Traffic Committee has actively watched the proceedings of the Rates Tribunal in matters arising out of the operation of the Railways Act, 1921, and has negotiated with the railway companies and the Board of Trade with a view to securing less onerous conditions for the carriage of dangerous chemicals by rail or by sea respectively.

The Association has also co-operated with the Association of Tar Distillers in matters relating to Gassing Accidents and to the constitution of Pitch.

Association of Tar Distillers

At the annual general meeting in March, Mr. H. Fergusson, of Burt, Boulton and Haywood, Ltd., was elected President, Mr. C. G. Lyon, of Stainsby and Lyon, Ltd., Vice-President, and Mr. J. H. Olliver, of The Gas Light and Coke Co., Honorary Treasurer.

The Association has considered the means to be adopted to give effect to the Chemical Works Regulations with a view to avoiding gassing accidents in stills, etc., and after consultation with the Chief Inspector of Factories is issuing recommendations to all its members.

The Association has prosecuted an inquiry with a view to securing a method of evaluation of pitch which will be acceptable equally to makers and buyers, and in this connection has sought the co-operation of the Fuel Research Board in a fundamental scientific inquiry into the factors which govern the binding power of pitch. The Association co-operated in the propaganda at Wembley and elsewhere with regard to the use of road tar.

British Chemical Plant Manufacturers' Association

At the annual general meeting in July, Dr. R. Seligman, of The Aluminium Plant and Vessel Co., Ltd., was elected chairman and Mr. J. A. Reavell, of Messrs. Kestner Evaporator and Engineering Co., Ltd., vice-chairman.

The Association has given much thought during the year to the future of the British Chemical Plant Industry, and has inaugurated a propaganda campaign to overcome the fetish for foreign plant. The industry suffers as much from this belief as did British Chemical industry in its earlier days; nevertheless, the Association is confident that British chemical plant is as capable of meeting British needs as is British chemical industry, and moreover, the latter depends for its ultimate success upon the prosperity of the plant industry. The Association has undertaken the task of acting as a clearing house for putting all British plant problems before British plant manufacturers, and with this end in view has secured the co-operation of plant manufacturers throughout the country, irrespective of whether they are members of the Association or not. The Association has co-operated with the Association of British Chemical Manufacturers in an inquiry into the utility of non-corrosive metals for plant construction; the inquiry is still proceeding.

British Chemical and Dyestuffs Traders' Association

During the year the work of the association has been mainly directed to protecting merchant traders' interests in connection with Part I of the Safeguarding of Industries Act, 1921, and the Dyestuffs (Import Regulation) Act, 1920. The association was successful in obtaining for merchants a special discount on purchases of reparation colours held by the Government.

The membership has gradually increased, and the association is now fully representative of the chemical and dyestuffs merchanting interests of the country.

The present officers of the association are: Chairman: Mr. Victor Blagden (Victor Blagden and Co., Ltd.); Vice-Chairman: Mr. Fredk. T. T. Reynolds (Millwards Merchandise, Ltd., Manchester); General Secretary: Mr. O. F. C. Bromfield. The offices are at 80, Fenchurch Street, London, E.C.3.

British Association of Chemists

During the present year the Association has greatly consolidated its position and its various activities have been developed and extended. The unemployment benefit fund during the three years of its existence has disbursed a sum of £2,487 and of this amount £942 has been paid out in the year 1924-5. The fund has not only benefited members who have been in actual distress through unemployment, but it has made it possible for chemists to negotiate for better conditions more agreeable to their status. The legal aid department has given advice in a large number of cases, and has to some extent specialised in the matter of agreements. Where an agreement has been regarded as unsatisfactory, but where a question of equity and not of law was involved, members have always been advised to refuse the contract, which, it is satisfactory to note, has in most cases been done.

The question of the organisation of the profession is now very much to the fore, and the Association has been very largely responsible for its wide ventilation. The Institute of Chemistry has been in communication with the Association concerning this matter, and is prepared to co-operate with it; so that important developments in this direction may be expected in the near future. The Association has been and remains convinced that some form of registration is necessary if the future of the profession is to be assured, and it has every right to congratulate itself that its efforts, in so comparatively short a time, should have borne fruit.

The literary propaganda of the Association has been energetically prosecuted, and through the courtesy of The Chemical Age, a very large number of articles relating to administrative problems of the profession have appeared in this journal.

The membership of the Association continues to increase in a satisfactory manner, but the Council hopes for and anticipates a more rapid addition to the ranks during the coming year. The unsatisfactory conditions of industry which have prevailed have undoubtedly deterred many from incurring even the slightly increased financial obligation which membership of the Association would demand, but the Council is assured that if the whole body of professional opinion were fully aware of the work that the Association has done and is doing directly for its members, and indirectly for the whole profession, its increase would, in a short space of time, be threefold. It may not be out of place, in this connection, again to point out that members of the Association can obtain rebate on income tax in respect of damaged clothing in most cases to an amount which more than covers the subscription.

The matter of the "Third Party" principle is one which is engaging the Association's attention, and some progress has been made in this matter. Not only the Association but the Society of Technical Engineers with some other societies are interested in this question, but, for reasons which it will not be out of place shortly to discuss, a rapid advance has not been made. On the one hand, the employers have not given this matter the consideration which is due to it since, in the great majority of cases, the technologist is still regarded exactly in the same light as an ordinary employee. The Trades Union Congress, on the other hand, have lately passed a resolution condemning third party ideas and those who attempt "to foist upon industry" such ideas. The Association continues to assert that it will not associate itself with any party or faction; whether employer and trade unionist recognise the fact or no, the technologist is a third party, and the Association will continue to press the claims of this third party until some such system as it advocates has at least been given a trial.

The Association has been applying itself to the question of social propaganda since it is convinced that the advance of the profession of chemistry depends largely upon an enlightened public opinion. The "area scheme" of the London Section has been evolved to assist in this since it is hoped that in these areas it will be possible to hold meetings of a social or semi-social character to which it might be possible to attract the public.

The Association has, during the year, greatly increased in prestige and influence. The energetic literary and social propaganda which has been carried out in some measure accounts for this, but the cordial relations which exist between the Association and kindred societies is also to a great extent responsible. The Council are gratified to note that the suspicion of the Association's aims, once so prevalent in some quarters, has given place to sentiments of confidence. This promises well for a closer co-operation between all societies of chemists, a co-operation which must be increased if the profession is to realise itself as one no less important than that of the law or medicine. H. T. F. R.

British Engineering Standards Association

The British Engineering Standards Association has recently issued a Specification No. 189, 1925, Cast Iron Filter Plates and Frames, which was prepared as a result of proposals received by the Joint Committee of British Chemical Manufacturers and British Chemical Plant Manufacturers Association. Adherence to existing practice was adopted as far as possible in the preparation of this specification with a view to minimising the introduction of fresh cloth widths, and enabling plates to be used in as many existing presses as possible. Only such features and dimensions as appeared necessary to efficiency and interchangeability without imposing undue limits on individuality have been specified.

The specifications in course of preparation for Chemical Lead for Acid Chambers and similar uses, and also for Regulus Metal (which will also contain appendices giving recommended methods of analysis) are well on their way to completion.

Proposals are also before the Association for the standardisation of a Cover for the Steam Jacketed Pans dealt with in B.S. Specification 186. B.S. Specification 188, Determination of Viscosity in absolute Units, which was published in 1923, is also now being revised by a Committee of the Association.

A committee has also been appointed to prepare standard specifications for Paints and Varnishes and the raw materials used in their manufacture, and it is hoped that seven specifications of interest to the engineering and allied industries will be ready for publication almost immediately.

The panel on Gas Cylinders has now completed, for recommendation to the superior committee, its proposals for standard dimensions for the Screw Threads in the Valve Stems and Outlets for Gas Cylinders.

Membership of the B.E.S.A. can be obtained for a minimum fee of £2 2s. per annum, which carries with it certain privileges, including a direct representation on the main executive committee through a duly elected advisory council, a free copy of each B.E.S.A. publication issued and additional copies at a reduced charge, and a right to apply to the organisation for advice on all matters of standardisation and simplification at home or abroad.

The Colour Users' Association

During the year the Colour Users' Association has continued its active work in the promotion and development of the general interest of dyers, and, as was pointed out in the annual report, a sub-committee had important interviews with representatives of the Government on the question of reparation dyestuffs. The Association has taken a keen interest in the reconstruction of the British Dyestuffs Corporation "upon which," in the words of Mr. Sutcliffe Smith, "the progress of the dyemaking industry in this country is so largely dependent." In his speech as chairman of the Colour Users' Association for the past four years, Mr. Sutcliffe Smith has persistently advocated that reconstruction of the corporation was essential if it were to function successfully, and during the past year each of his three suggestions has been put into effect, to the satisfaction of the dyeing trade. Dr. E. F. Armstrong having been appointed managing director, the corporation is now managed by one who has been "brought up in the industry," and the necessary financial reconstruction has been carried through, with the removal of government interest in the concern. The motion for reconstruction was, in fact, seconded by Mr. Sutcliffe Smith at the meeting of the Corporation on November 25.

The last report issued by the Association shows that membership stands at 217, while the Council has been strengthened by the election of Messrs. P. Ermen (English Sewing Cotton Co., Ltd.) and H. Yarwood (W. Lowe, Ltd.), representing the Hosiery Dyeing Group, Mr. James Ewing (Bradford Dyers' Association) having been co-opted. Upwards of 100 circulars have been forwarded to members, dealing mainly with reparation dyes and alterations of prices, while the balance sheet showed cash in hand to the amount of £3,965.

The Faraday Society

The practice has now been established of holding two General Discussions a year, one on a theoretical and one on a technical subject. In addition to these discussions, four ordinary meetings took place during the past year, at which twenty-four papers were presented dealing with numerous aspects of physical chemistry, pure and applied. The technical discussion in 1925 was held on June 8, the subject being "The Physical Chemistry of Steel-Making Processes." This was held jointly with the Iron and Steel Institute. An opening address was delivered by Sir Robert Hadfield, a past-president of both societies, and this was followed by an important paper by Dr. A. M'Cance on "Balanced Reactions in Steel Manufacture." Then followed seven further papers, of which three came from America. The papers and discussions between them well covered the whole of our present knowledge of this subject.

The theoretical subject discussed was "Photochemical Reactions in Liquids and Gases." The meeting was held at Oxford on October 1 and 2, and it was largely attended and highly successful. Oxford itself is now a centre of research in this subject, and there also attended distinguished photochemists from Cambridge, London, Liverpool, and elsewhere, as well as a contingent from Germany, and representatives of American, Danish, and Dutch science. In addition, papers were received from France, Russia, Switzerland, Yugo-Slavia, and India. In all, some thirty papers were presented, and lively discussions took place. The subject was divided into two sections: Part I, "Einstein's Law of Photochemical Equivalence," to which Professor A. J. Allmand contributed the introductory paper; Part II, "The Mechanism of Photochemical Reactions," which was opened by Professor Max Bodenstein.

We are informed that the report of the former discussion is just appearing, and that of the latter, to which will be attached as an afterword a summary of the whole proceedings by Dr. E. K. Rideal, will appear early in the new year.

Particulars of the Society may be obtained from the Secretary, at 90, Great Russell Street, London, W.C.1.

Institute of Chemistry

The Institute has made further progress in the organisation of the profession, and its membership roll now exceeds 5,000. The standard of qualification has been fully maintained, the Regulations being under careful review with the advance of theory and practice. In January, 1925, the Council held a Conference of Professors of Chemistry and Heads of Departments of Applied Chemistry, with the Board of Examiners of the Institute, to consider the place of applied chemistry in the training of chemists, and, at a Conference held at York, the Institute again discussed the conditions for the admission of Associates and Fellows.

The Council, while adhering in the main to the policy underlying these conditions, has under consideration the possibility of making provision to meet the cases of candidates who have had long experience in positions of responsibility and who may reasonably be held to have qualified for the Associateship, although they may not in all respects have fulfilled the requirements as to University training.

Also, at the York Conference, the Council was urged to enter into collaboration with other Societies interested in chemistry and to formulate and press forward a scheme for

bringing these Societies into closer co-operation and fellowship. The President showed that the Institute had substantially co-operated with the Chemical Society in the matter of providing a national chemical library; with the Society of Public Analysts in matters affecting the administration of the Sale of Food and Drugs Acts, and the Fertilisers and Feeding Stuffs Act, and with other professional and technical Institutions in matters affecting patents, the treatment of professional Civil Servants, the protection of professional designations, and the rights and privileges of Chartered Bodies. At the same time, the Local Sections of the Institute had actively co-operated in all parts of the country with the Local Sections of the Society of Chemical Industry and allied societies. It is clear that the Institute and its Council are sympathetic and ready to collaborate if asked to do so in any movement of its kind.

Local Sections have been increasingly active in providing programmes of interest for the members within their respective districts. Among the papers read during the year, mention may be made of the paper by Professor Armstrong on "Exercises in the Gentle Art of Smoking: A Mixed Grill," before the Huddersfield Section in February; Professor Comber on "Agricultural Chemistry as a Career," before the Leeds Section in January; Dr. Gibson on "The Union of Chemical Societies," before the Belfast Section in March; Mr. H. J. Evans on the Regulations of the Institute, before the Liverpool Section in February; Sir Max Muspratt on "Chemistry and Civilisation," before the London Section in March; Mr. R. W. Blair on "Chemistry in Relation to Public Affairs," before the Malaya Section in February; Mr. William Rintoul on "Library and Office Organisation for Chemists," before the London Section in April, which was supplemented by suggested instructions on the drafting of reports; and Mr. W. J. U. Woolcock on "British Chemical Industry," before the Bristol Section in October.

The matters that have received the special attention of the Council include the Pharmacy and Poisons Bill (Northern Ireland); the Departmental Commission on Local Administration in Northern Ireland; the proposed new Fertilisers and Feeding Stuffs Bill; Government scientific publications; the Royal Commission on National Insurance; and the fees allowed to professional chemists in forensic matters. The Institute is also associated with the Society of Chemical Industry and the Institute of Metals in promoting the establishment of a memorial to the late Sir George Beilby, the object of which will be to provide awards to British investigators in science to mark appreciation of records of distinguished original work, preference being given to investigations bearing on problems connected with fuel economy, chemical engineering, and metallurgy.

With the rapidly growing membership of the Institute some anxiety has been felt that the problem of finding employment for newly qualified chemists might become increasingly difficult of solution; the situation has been serious at times, but the statistics of the Appointments Register show a steady decrease in the number of members without appointments. There is good reason to think that not only the strictly chemical industries but many of those which do not come under that category are engaging chemists to assist them in combating the effects of industrial depression. The appeal issued by the Benevolent Fund Committee earlier in the year resulted in a substantial response with an increase of about 300 in the number of subscribers; so that the Committee was enabled to deal generously with cases of hardship brought to its notice. With this encouragement the Committee has also felt justified in applying donations—as distinct from annual subscriptions and contributions for current purposes—to the establishment of an annuity fund, and has elected the first annuitant.

The Students' Association in London has paid many visits to important works and laboratories, and has continued to hold debates and other social functions.

The scheme of examinations for the award of National Certificates in Chemistry, which was introduced some years ago in conjunction with the Board of Education, already shows its influence on chemical education in technical schools and colleges. This scheme has now been extended to Scotland, in conjunction with the Scottish Education Department, and to Ireland with the Ministry of Education, Belfast.

Institution of Chemical Engineers

The past year has been a very active one for the Institution of Chemical Engineers, and its membership has increased to 321, including 166 members, 118 associate-members, and 37 graduates and students.

At the beginning of the year a special invitation was given to the American Institute of Chemical Engineers to visit this country, and to hold a joint annual meeting. Fifty-five American friends arrived on July 11, and after spending three days in Liverpool, during which Lake Vyrnwy, Liverpool University, Liverpool Cathedral, and other places of interest were visited, four days were spent in Leeds, attending the annual meeting of the Society of Chemical Industry, and the joint annual meeting of the two institutions was held on Friday, July 17, in the Philosophical Hall, Leeds. On the same evening the party took train for Glasgow where three days were spent, the first in visiting Nobel's Explosive Factory, Ardeer and Turnberry, the second in visiting the Trossachs, and the third in being entertained by the Corporation of Glasgow on their new sewage boat—s.s. *Dalmarnock*—for a trip down the Clyde.

Edinburgh was visited on Tuesday, where the party was entertained by the Corporation, and the Forth Bridge and the beauties of Edinburgh were seen and admired. Train was then taken for the Lake District, where two days were spent in touring round, and finally the party arrived in Chester, where the annual dinner of the Institution was held at the Grosvenor Hotel.

The works of Joseph Crosfield and Sons and the United Alkali Co. were visited on July 24 and 25 respectively, and there is little doubt that these visits and the generosity of the firms in question will always be remembered by the American visitors.

On Sunday, July 26, Shakespeare's birthplace was visited, and by the kindness of the Trustees all Shakespearean matters of interest were laid open.

The visitors were entertained at the British Empire Exhibition, Wembley, on Monday, a dinner being held in the evening in the Garden Club.

Visits were made on Tuesday to the House of Commons and other places of historic interest, and in the evening a reception was held at Leighton House, when Lord Balfour received and welcomed the American visitors.

On Wednesday morning Sir Robert Hadfield exhibited to the American visitors some of his recent developments in non-corrodible steels and iron, and the party left for Paris on the following day, for the continuation of their European tour.

The work of the Education Committee of the Institution in formulating a scheme for the training of chemical engineers has been continued, and steps have been taken to bring the matter before all the educational authorities of the country. It is to be hoped that, before long, courses of study in chemical engineering will be arranged at all our important teaching institutions through this activity.

An important development during the year was the formation of a chemical engineering library under the able management of Mr. T. C. Finlayson. A library bulletin is issued by the hon. librarian every quarter.

Another important activity was the formation of an Appointments Bureau, to which Mr. H. J. Pooley was appointed hon. director. This bureau is run on novel lines and has been extremely successful. The hon. director is in full charge and all his work is confidential. He takes an active part in considering the candidates for the various posts, so that the institution takes some responsibility in the provision of suitable men.

On October 14 last, the new session was opened with a reception, held in the Science Museum, in order that the new President of the Institution, Sir Frederic Nathan, K.B.E., could meet all the members. This reception was a great success, and was probably the first attempt of a scientific society to bring the treasures of the Science Museum before the notice of its members in a direct fashion.

The Chemical Society

The Chemical Society was founded in 1841, and received its Royal Charter in 1848. The object of the Society, as laid down in the charter, is the general advancement of chemical science by the discussion and publication of new discoveries, and the interchange of valuable information respecting them

Under the terms of the supplemental charter granted in 1920, the membership consists of Fellows and honorary Fellows. Fellowship is open to members of either sex. Every candidate for election as a Fellow must be proposed according to a form of recommendation subscribed by not less than three Fellows of the Society to whom he is personally known. In the case of a candidate resident abroad who is unable to obtain three signatures, the council has the power to accept a certificate signed by one Fellow of the Society. The annual subscription is £3. The admission fee (£3) has been remitted for a time. The total membership now exceeds 4,000.

The affairs of the Society are conducted by a council, elected by Fellows from their own body, consisting of the president, not more than twelve vice-presidents, the treasurer, secretaries, and eighteen ordinary members of council.

The ordinary scientific meetings are held at Burlington House as a rule twice a month from October to June, at which scientific papers are read and discussed, while in accordance with a scheme of co-operation between the Society of Chemical Industry and the Chemical Society, Fellows resident in the provinces are afforded facilities for attending, and reading papers before the provincial local sections of the Society of Chemical Industry. Lectures by men eminent in chemistry and the allied sciences are also delivered from time to time.

The Society publishes monthly the Journal, consisting of original memoirs communicated to the Society and of special lectures, while the volume of the Annual Reports dealing with the recent progress of chemistry in its various aspects is published in March of each year. The volume of Abstracts in Pure Chemistry (issued by the Bureau of Chemical Abstracts) comprises comprehensive abstracts of papers appearing in recent British and foreign journals, and is issued monthly to Fellows free of charge. By a mutual arrangement between the American Chemical Society, the Society of Chemical Industry and the Chemical Society, members of any one of these Societies may obtain the publications of the other two on privileged terms.

Owing to the heavy cost of publication and the increasing number of papers received for the Journal, a Publications Fund has recently been established, the income from which it is hoped will be large enough appreciably to relieve the general funds of the Society from some of the expenses of publication.

The Society possesses a Research Fund, from which grants are made twice a year for the purchase of materials required for research. During 1924, 120 applications for grants amounting to £1,802 were received, the sum granted being £845. Owing to the amount applied for each year exceeding the sum available for distribution, prior consideration is given to applications received from Fellows.

The library, which contains 28,500 volumes, is open from 10 a.m. to 9 p.m. each day, except on Saturday, when it closes at 5 o'clock, to Fellows to the Society and to members of the following contributing societies: Association of British Chemical Manufacturers, Biochemical Society, Faraday Society, Institute of Brewing, Institute of Chemistry, Society of Chemical Industry, Society of Dyers and Colourists, and the Society of Public Analysts, who may consult and borrow books. The attendances during 1924 numbered 6,652.

The present officers of the Society are; President, Arthur W. Crossley, C.M.G., C.B.E., LL.D., F.R.S.; treasurer, Jocelyn F. Thorpe, C.B.E., D.Sc., F.R.S.; secretaries, T. Slater Price, O.B.E., D.Sc., F.R.S., and C. S. Gibson, O.B.E., M.A.; foreign secretary, F. G. Donnan, C.B.E., LL.D., F.R.S.; assistant secretary, S. E. Carr, F.C.I.S.; librarian, F. W. Clifford.

Society of Chemical Industry

As a result of the propaganda that has been carried on throughout the year, the influx of new members for 1925 has been much larger than in any year since 1920; 475 new members were elected, of which 317 are resident in this country, and 158 abroad. This increase in the membership is, no doubt, to some extent due to the effect of the entrance fee having been suspended during the year, and the Council has decided to continue the suspension during 1926.

The annual meeting in Leeds was an unqualified success, and the attendance of members was excellent. The Society had the pleasure of welcoming a number of members of the American Institute of Chemical Engineers, who had come to England to attend the annual meeting of the Institution of Chemical Engineers, which was held in Leeds during the meetings of the Society, and the American Institute has recorded in most generous terms its great appreciation of the advantages its members derived from joining with the Institution and the Society on this occasion. The members were very cordially welcomed to Leeds by the Lord Mayor and Corporation, and were generously entertained by many firms in Yorkshire, including the British Dyestuffs Corporation, British Oil and Cake Mills, and Messrs. Rowntree, of York. The excursions included a visit to York (with a reception by the Lord Mayor), and a whole day's excursion to Wharfedale. The Society's Annual Medal for 1925 was awarded to Mr. Walter F. Reid, a former President of the Society. The next annual meeting will be held in London in July, 1926.

Dr. H. Levinstein was appointed hon. foreign secretary, in place of Sir Wm. J. Pope, K.B.E., F.R.S., who was elected a vice-president.

The Society has lost by death during the year two of its former presidents (Professor C. F. Chandler of New York, and Sir Edward Thorpe, C.B.), and the Messel Medallist for 1924, Viscount Leverhulme.

The Society associated itself with the British Chemical Dinner, organised by the Chemical Industry Club, which was held in London on November 13.

The Society continues to be represented on a large number of outside bodies, of which a list was given last year (THE CHEMICAL AGE, December 27, 1924), and it is now represented on the recently formed British National Committee of the World Power Conference.

The Council continues its co-operation with the Council of the Chemical Society in the work of the Bureau of Chemical Abstracts, and arrangements have been made for the adoption in the case of both sets of abstracts of the same format and the same type, as well as for the elimination of any overlapping.

Delegates were sent to the following Conferences held during the year:—The Fifth Congress of Industrial Chemistry in Paris, the Royal Microscopical Society in Sheffield, and the centenary of the celebration of the discovery of benzene by Faraday, at the Royal Institution. Representatives of the Society have been appointed to attend the celebrations to be held in Palermo, about Easter, 1926, of the centenary of the birth of the Italian chemist Cannizzaro, and the World's Forestry Conference to be held in Rome in May, 1926. The Society will also associate itself with the Optical Convention to be held in London in April, 1926.

Society of Glass Technology

The Society has, during the year, held nine meetings, three at Sheffield, the headquarters of the Society, three in London, and others at Birmingham, Newcastle, and Leeds. The papers read at these meetings covered a wide field, but particular mention may be made of the two days' meeting held on May 25 and May 26 in London, at which a series of papers was read by investigators from England, U.S.A., France, and Germany, on the constitution of glass, and after which a general discussion followed. In all, 31 papers were communicated during the year.

The membership of the Society on December 31, 1924, was 633, of whom 413 were resident in the British Isles, and 220 distributed among 18 other countries. During the year 5 collective and 50 ordinary members were elected to membership.

The Society's financial position was shown at the annual meeting in April to be sound, a balance of £133 16s. 5d. remaining. The Society has, for the first time, this year made grants in aid of research, the total amount disbursed being approximately £130.

The present officers of the Society are:—President, Mr. T. C. Moorshead; Treasurer, Mr. J. Connolly; Secretary, Professor W. E. S. Turner. Communications in respect of membership or of the work of the Society may be addressed to the Secretary, Society of Glass Technology, The University, Darnall Road, Sheffield.

Benefits Conferred on Mankind by Chemical Research

By Dr. G. C. Clayton, M.P.

We are indebted to Dr. G. C. Clayton, M.P., a director of the United Alkali Co., for the following notes of his address on "Some benefits conferred on mankind by chemical research," which was broadcast from the London B.B.C. Studio on Thursday, December 17, and which is published by permission of the Radio Association.

In considering this subject, it is as well first of all to try to appreciate what are the material essentials of our modern civilisation—namely, adequate housing, adequate clothing, adequate food, and health to enjoy these advantages—and then to attempt to show in what way chemical research has supplied us with these advantages.

Adequate Housing

Without glass the modern house could not exist, and whilst the discovery of glass dates from as early as the Egyptian era, one must remember that even in those remote ages chemical research existed, and that we are reaping to-day the advantages of those early investigations. They produced wonderful results, but could only make articles such as small glass bottles. Their work has been continued throughout the centuries, so that we enjoy as the result glass in all its manifold varieties and uses. Through the use of glass we have sunlight in our homes, and for artificial light the electric bulbs.

A research chemist as recently as 1792 discovered the possibility of coal gas giving us the means of heating and lighting. By heating with gas we can avoid one of the curses of modern civilisation, namely, smoke, and by utilising the further discovery of the incandescent mantle, gas lighting has been enormously improved. The light given out by an incandescent mantle penetrates fog better than any form of electric light, and for this reason is employed in lighthouses and also in some of the principal London streets, such as Parliament Street in front of the Houses of Parliament. There are certain parts of the world where it is impracticable to light with gas or electric light, and there chemists have provided another substitute, namely, acetylene from carbide. The carbide is easily carried, and the light obtained has great lighting power.

How many of us, when he or she strikes a match, realise the amount of research which was needed to give us this apparently simple source of light? It required the shortage we experienced during the war to prove how dependent we are on matches. Match heads contain, amongst other ingredients, chlorate of potash, and as the potash comes almost exclusively from Germany, we in this country had to revert to the old method of extracting potash from the ashes of seaweed; and from this source and from the flue dust of blast furnaces, which was a new discovery, we were just able to keep this country supplied with matches.

In considering adequate housing, one must not forget the supply of pure water and sanitation. Natural pure water is, of course, the best, but in many districts it is impossible to obtain. Still, indifferent supplies can, by treatment with chlorine gas, be made safe, and the danger of such plagues as cholera and typhoid removed. During the war, great use was made of chlorine as a water purifier, so that many lives were saved by its use, as a set-off against those lost by its abuse as a poison gas.

Whilst we all deplored the use of poison gas during the war, I think we ought to acknowledge our debt to the research chemists who investigated the nature of each new gas introduced, and, working at great speed and with grave risk, produced the means of protection, so that we can boast that our troops were the best protected against this insidious peril.

The subject I have taken is so vast that it is impossible to enumerate all the benefits derived from chemical research, but soap, galvanised articles, tins for tinned goods, electroplate, and many other articles have been placed at our disposal by the work of earlier investigators.

Adequate Clothing

My next essential is adequate clothing. In the earliest days fig leaves, and, later, skins constituted the clothing of our ancestors. Now we have fabrics of wonderful texture and of wonderful colouring. The preparation of the cloth is to a considerable extent due to chemical treatment, which is used to eliminate impurities in the raw material, and to bleach the fabric to snowy whiteness. In the past sunlight was the only means of bleaching, but here, again, chlorine in one or other of its forms provided a more rapid and, in our northern climate, a more certain agent. How dull the world would be with only white or natural-coloured fabrics, but the early investigators found means of dyeing fabrics with extracts from plants, such as indigo, these dyes being now largely replaced by artificial dyes, made available by the historical research of Perkin, who, less than 70 years ago, made the dyestuff "Mauve" from coal tar. Since then, all over the world chemists have produced the vast series of dyes which rejoice our eyes. The latest contribution of chemists to the supply of clothing is, of course, artificial silk. This contribution was largely due to the work of two British chemists, Cross and Bevan, and enables wood pulp to be converted into the artificial silk we know, which in many respects equals natural silk, and is produced at a price making it available for those who could not afford the natural product.

Food

With our increasing population the provision of food becomes a very serious problem, and in many countries the maintenance of existing supplies is even difficult. One must remember that every time a crop is removed from the field, the soil has lost something which must be returned if the next crop is to be equal to the previous one. In the past this loss was largely met by farmyard manure, but with the replacement of horses by motors, and the vast importation of meat from overseas, the supply of farmyard manure is insufficient. The chemist, however, by analysis of the soil and study of the requirements of each crop, has provided the necessary substitute for an efficient intensive cultivation. Phosphate rock, found in many parts of the world, is treated with sulphuric acid, and gives one of the essentials; then nitrate of soda from Chile, or ammonia from the gas works, and potash from Germany or France, complete the plant requirements. The latest chemical development is the production of ammonia from the air, providing us with a new source of soil enrichment. This invention is extremely clever and was first developed in Germany, but we now possess in this country a thoroughly efficient plant in operation on a vast scale.

I mentioned the importation of meat from overseas. This has only been made possible by the work of chemists who provided the means for chilling and refrigeration, ammonia and calcium chloride each taking part in the production and use of the principles of refrigeration.

Amongst the latest discoveries of research chemists is the production of sugar from carbonic acid and water, proving that what is produced by nature can be repeated in the laboratory. Though the quantities produced are extremely small, this important discovery may be the forerunner of vast change in our food supplies.

Health

What would all these benefits be worth if we had not health to enjoy them, and how have research chemists contributed to ensuring us health? I have already referred to the provision of pure water, but we must not forget sanitation. Our vast cities could not exist without the care bestowed on sanitation, and the removal and making innocuous of the refuse. Sewage farms are provided for all large cities, and each must be equipped with chemists to watch and investigate every problem presented. As a result of the care taken, we have at least an additional ten years added to the average length of life during the last 25 years, which may or may not be considered a benefit.

But when we come to surgery and dentistry we must acknowledge the benefits of anæsthetics. When we consider the terrible scenes perpetrated in the surgeries only a few years ago, and the horrible effects of dirty instruments, we have every reason to be grateful to Sir James Young Simpson and Lord Lister. The work of research chemists has provided

means for disinfection and for producing insensibility to pain, making it possible to perform most wonderful operations. In the past such medicinal benefits as were available were derived from plants, but often one constituent of the plant was beneficial and another the reverse. Chemical research has succeeded in separating the good from the bad, and in many cases provided a purer and cheaper source of supply. Much as we may deplore the too extensive use of medicines, we all acknowledge that they are essential sometimes.

I hope what I have said will indicate some of the benefits already conferred by chemical research, but I believe we are only on the threshold, and that it is most essential for our national well-being that we should be in the forefront of the battle. I am glad, therefore, that we have under the Government a Department of Scientific and Industrial Research, which, besides conducting research itself, such as the low temperature carbonisation of coal, also stimulates research in other institutions.

I should like, in conclusion, to acknowledge the debt we, as chemists, owe to those of our nation, who, scattered over the world, provide us with the raw materials for our work, and, having just returned from the mines in the South of Spain, where, amongst other things, they produce the raw material for sulphuric acid—and where I found they also have wireless—I feel you would like to join with me in sending them our greetings.

Spain as a British Market

By Dr. S. P. Schotz

I HAVE just returned from Spain after a month's sojourn in that country. The development of Spain has received considerable impetus since the reins of Government have been taken over by General Primo de Rivera, owing to the peace and order which now prevail everywhere. Corruption and bribery are being put down with a firm hand. Life and business are properly protected. The mineral riches of the country and the subsidiary industries are far from developed. The modernisation of sanitation and water demands very large supplies of earthenware, lead sheeting, and pipes, yet there are very few works of that description. Wherever I went, I found numerous German agents, while British commercial travellers were practically unknown. At the same time the retail prices of various goods are so high that any alleged difference in price between British and German goods could not come into question at all.

British Repute for Quality

Spanish manufacturers, with whom I came in contact, admitted that although British machinery was somewhat higher in price than German, yet it was better and more lasting. In many instances it is simply owing to lack of proper British representatives that Germans rule the market. Many German firms have Spanish agents, and I know well such an agent of a German machinery manufacturer who succeeds in getting better prices for inferior goods than a well-known English manufacturer of similar commodities who is not properly represented. The few English firms that are established in Spain in connection with development of mines, etc., prefer to export copper, lead, mercury, etc., without even attempting to establish local works, although labour is very cheap and the people are sober.

Perhaps in making such statements I neglect the importance of income tax, etc., which would have to be considered by directors of British firms, but in spite of that a fair amount of profitable business could be done by developing English imports. All raw materials connected with railways, motor-cars, electric cables, bulbs and other electric appliances have a very great future, and it is surprising that British firms have done so little while Americans are importing immense quantities of goods (including Ford cars that rule the market) in spite of excessive freights.

British Chemicals on Sale

Life according to British standards is not so cheap as one might expect, even though one can buy a bottle of quite passable native wine for 4d. Margarine, butter, cheese, cheap paints and varnishes, joiner's fittings, soaps, polishes, lubricants, boot blacking, rubber goods, proprietary drugs, tooth pastes, etc., cheap clothing and everything connected with wearing apparel and private luxury should find a ready market everywhere. I noticed in many druggists' shops even in small towns the productions of a well-known English chemical concern, which shows that enterprising firms will always be able to hold their own. It is all a matter of business organisation, of approaching the buyer and advertising goods in the Spanish tongue, of using measures, weights, packing, etc., to which the people are accustomed.

Whatever our daily press may say about the Riffian war, its effect on Spanish industrial and social life appears to be quite negligible, apart from its problematic influence on the rate of exchange. If anything, the war helps to wake things up.

X-Rays in Industry

THE third meeting of the current session of the local section of the Society of Chemical Industry was held last week in the form of a joint meeting with the Chemical Society and the Institute of Chemistry. Mr. George Gray presded.

A paper was read by Mr. S. H. Piper, B.Sc., on the use of X-rays in chemistry, who said that during the last few years a large number of investigators, building on the foundations of Laue, Sir William Bragg, and W. L. Bragg, have been extending the use of X-ray spectroscopy to the elucidation of chemical problems. The researches fall into two main groups—one the detection of substances by their X-ray spectrum, the other the determination of composition by crystal structure. A good instance of the first group was the discovery of hafnium by Coster and Hevesey. Thanks to the work of Moseley, the characteristic spectra of all the elements that could exist between hydrogen and uranium were already known, even for the elements not yet isolated. A great amount of work on the exact structure of many organic and inorganic compounds had been carried out in Sir William Bragg's laboratory. These experiments give information as to the behaviour of molecules in the solid state, while the usual chemical investigation dealt with substances in solution. Polyani had made many measurements of the X-ray diffraction patterns yielded by fibrous substances, and had also used the same methods to examine the structural changes due to strain. Another set of measurements made on the alipathic compounds promised to be of value in organic analysis. The methods were still in their infancy, and important developments may be expected.

British Industries Fair

RAPID progress is being made with the organisation of the British Industries Fair, which opens concurrently in London and Birmingham in February next. Allocation of the numerous halls at the White City to the various trades is now taking place, and the Department of Overseas Trade, which is organising the London section, has decided to assign at least two of the main halls to exhibits of china, earthenware and glass, and toys and games. In other halls, amongst other exhibits, will be shown musical instruments, fancy goods, stationery, leather and leather goods, sports goods, chemicals, silver and plate, furniture, foodstuffs, cutlery, brushes, paper, printing, clothing, jewellery and wireless. In addition to these a separate section will be allotted to the Dominions and Colonies.

The Birmingham Chamber of Commerce, which, with the support of the Department, is organising the Birmingham section of the Fair, has already booked 10,000 ft. in excess of the 1925 Exhibition, when, owing to the continuance of Wembley, both the London and Birmingham sections were held in Birmingham.

The demand for space in the various sections both in London and Birmingham is such that it is expected that before the end of the year all the available space will be allocated.

Japan's Artificial Dyestuff Production

THE manufacture of artificial dyestuffs in Japan during the first six months of this year amounted to 4,678 kilos, and intermediates amounted to 2,548 kilos, compared with 4,494 kilos and 1,509 kilos respectively for the corresponding period of 1924. Only 14 of the 33 existing plants are now working, and a considerable falling off in production figures for the last half of the year is anticipated.

From Week to Week

LORD LEVERHULME arrived at Southampton on Saturday, December 19, from New York.

TRADE DISPUTES in the chemical industry from January to November this year have been 11 in number, involving 1,000 workers and 25,000 working days in all.

MR. EDWARD J. SHORTT, director of the Old Strand Chemical and Trading Co., London, returned on Tuesday from a visit to New York and the West Indies.

A TURPENTINE-TAR REFINING FACTORY and a pitch factory to produce up to 600 poods a day have been erected near Archangel and are reported to be operating successfully.

AFTER BEING KNOCKED DOWN by a motor 'bus, Mr. Hugh Young, cashier at the works of William Jarvie, chemical manufacturer, Coatbridge, died on Friday, December 18, from injuries received.

THE SALE is announced and will shortly take place, of the Ward Street Dye Works, Blackburn, and also of plant, machinery, and stocks of chemicals. Further details may be obtained from R. Hoyle and Son, 4, St. Ann's Square, Manchester.

THROUGH THE INSTRUMENTALITY OF DR. G. C. CLAYTON, M.P., and Mr. J. H. Smith, the United Alkali Co., Ltd., has undertaken to defray the whole cost of the equipment of a clinic for orthopædic treatment that the Officer of Health wishes to establish in Widnes.

A FIRE occurred at Woolwich Arsenal on Monday evening, when a wooden building and its contents were considerably damaged. Little information is offered by the authorities, but it is understood that an explosion preceded the fire and that it broke out in a hut in the research department, not far from the scene of the disastrous fire some months ago.

MR. G. D. ELSDON, F.C.S., F.I.C., who has held the office of Public Analyst of Salford since 1914, has been appointed by the Lancashire County Council to succeed Mr. Collingwood Williams, who is shortly retiring, as County Analyst. Mr. Elsdon is a member of Manchester sections of the Institute of Chemistry and the Society of Chemical Industry.

INSULIN FROM VEGETABLES is a practical possibility according to Professor Brugsch, of Berlin University. He has, it is reported, extracted insulin from acorns which has been concentrated in tabloid form. It is claimed that by this means the insulin will be considerably cheaper. Tabloids of concentrated animal insulin, under the name of insulingual, have been on the market for some time but at a prohibitive price.

MR. BENJAMIN T. BROOKS, chemist and consulting engineer, has been elected chairman of the New York Section of the American Chemical Society for 1926. Mr. Brooks succeeds Professor James Kendall of Columbia University. Professor Arthur W. Thomas of Columbia was elected vice-chairman, and Mr. D. H. Killeffer, associate editor of *Industrial and Engineering Chemistry*, was re-elected secretary and treasurer, a post he has held for three years.

RECENT WILLS INCLUDE.—Mr. W. Whewell, of Bury, of J. and W. Whewell, manufacturing chemists, of Radcliffe, £31,612 (net personalty, £31,452).—Professor H. Maxwell Lefroy, of the Imperial College of Science and Technology, South Kensington, who was fatally gassed in his laboratory in October, £1,268.—Mr. W. W. Webster, of Lindfield, Sussex, who introduced the cyanide process for the extraction of gold into South Africa and who was a director of several mining companies, £117,307 (net personalty, £96,286).

THE SOCIÉTÉ ANONYME DES FOYERS AUTOMATIQUES, of Paris, the associated company of International Combustion, Ltd., have recently received contracts for the following Lopulco Pulverised Fuel Equipment. Livorno Contrale, complete equipment for four boilers; Sarre-et-Moselle, complete equipment for two boilers; Fonderie des Ardennes, complete equipment for an annealing furnace of 13 ovens; Bressous Centrale, complete equipment for two Ladd-Belleville boilers. Other contracts recently received include five air reheaters each having an area of 17,000 sq. ft. and six suspended arches.

MR. JUSTICE TOMLIN in the Chancery Division on Monday gave judgment in an action (see THE CHEMICAL AGE, November 28 and December 5) by Mr. William Guy-Pell, of Hyde Park Place, W., claiming damages from Mr. Joseph Day for alleged fraudulent misrepresentation, in connection with the purchase of shares in the Catalytic Chemical Co., Ltd., or alternately, for compensation under the Companies Act. The plaintiff's case was that by defendant's representations he was induced to purchase certain shares. Defendant denied the allegations, and declared that the plaintiff invested in the shares after seeing the plant at the company's factory. His Lordship said he accepted the story told by the plaintiff. Many of the statements in the document were untrue, and he held that defendant used the document recklessly and in no real belief that the statements in it were true. But he (the judge) did not think there was any misrepresentation in regard to the statement as to Sir Robert McAlpine's company finding capital. His Lordship found that the plaintiff was entitled to recover damages in respect of all the shares, with costs.

EXTENSIONS at the Grangemouth soap works of the Scottish Co-operative Wholesale Society are to cost £6,500.

THE PRICE OF PETROL in Great Britain is not to be changed in spite of a further rise in the price of Pennsylvanian crude oil.

THE ANNUAL DINNER of the Birmingham and Midland Section of the Society of Chemical Industry and the Institute of Chemistry has been fixed for January 23, at the Engineers' Club, Birmingham.

DR. HUGH K. MOORE, of the Brown Co., Berlin, N.H., has been elected president of the American Institute of Chemical Engineers to succeed Dr. Charles L. Reese of the du Pont Co. Dr. Moore was Perkin Medallist in 1924.

PROFESSOR F. C. LEA, D.Sc., of Sheffield, and formerly of Birmingham University, has been awarded the T. Bertrand Hill Prize by the Institution of Mechanical Engineers for his paper on "The effect of low and high temperatures on materials."

A VERDICT of "Misadventure" was recorded at the inquest on Saturday, December 19, on Walter Boardman, 55, manager and works director at J. F. and E. Caulfield's bleach and dye works, Newton-le-Willows. He was found fully clothed in a reservoir at the rear of the works.

THE GOVERNMENT HAS DECIDED that holders of the official invitation cards to the British Industries Fair may have their passports to England viséd without any charge being made. Invitation cards may be obtained from the nearest British Consul or from the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

REPORTS FROM RUSSIA state that whereas last year the textile industry drew some 15 per cent. of their dye requirements from home sources, this year the programme of the Aniltrust provides for the supply of 30 per cent. Steps are also being taken to increase materially the soda production as at present the output will not meet the needs of the glass industry.

THE ANNUAL DINNER of the Midland Varnish, Paint, and Colour Manufacturers' Association was held in Birmingham on Friday when Major C. A. Mander, of Wolverhampton, presided. Mr. A. Selby Wood, president of the National Federation, pointed out that the Federation had now taken up the question of chemical research in regard to the materials used in the industry.

THE CHEMICAL ENGINEERING GROUP of the Society of Chemical Industry announces a meeting to take place on Friday, January 8 next, in the Hall of the Chemical Society, Burlington House, Piccadilly, W., at 8 p.m., when the following papers will be read:—"The Manufacture of Hydrogen suitable for the Hydrogenation of Oils," by Mr. A. Edgar Knowles; "The Production of Hydrogen by Micro-organisms," by Dr. A. C. Thaysen. The chair will be taken by Mr. C. S. Garland.

WE ARE AUTHORISED to state that the shareholders of Herbert Green and Co., Ltd., manufacturers of industrial alcohol, etc., of Hull and London, have accepted the offer of the Distillers Co., Ltd., Edinburgh, for the purchase of the whole of their issued capital. The terms (as reported in THE CHEMICAL AGE of December 5) were the payment of 25s. for the ordinary and 2s. 6d. for the deferred shares, and Mr. Herbert Green, managing director, was to be retained and special compensation of £10,000 paid to him. The issued capital consists of 145,000 fully paid shares of £1 each and 125,000 deferred shares of 1s. each.

SEVERAL ARTIFICIAL SILK DEVELOPMENTS are reported. It is stated that of the recent share issues underwriters had to take up about 85 per cent. of the Western Viscose and about 45 per cent. of the Apex.—It is understood that the Enka Co. is not to take up its option on the shell factory at Aintree, but is now interested in a site near Manchester.—Berlin reports announce the conclusion of an agreement between Courtaulds, Ltd., of London, and the Vereinigte Glanzstoff Works, Ltd., of Elberfeld, for the erection of new artificial silk works in Germany. The new firm will be known as the Glanzstoff Courtauld, Ltd., and will at once erect new works to produce Viscosa silk. It is expected that the new works will produce ten tons of silk daily.

THE LAW concerning the regulation of the German potash industry which would have come to an end on December 31, has been prolonged for three years, because of the unfavourable situation of German agriculture. The law was initiated in 1916, forbidding the sinking of new potash pits, and was prolonged in 1921. It is reported that the Bremen Senate is at present discussing with the potash syndicate a proposal to make Bremen an overseas export harbour for potash, as the discussions with the Hamburg Senate have failed. It has been stated by the Wintershall concern that no dividend could be paid for the past year, but that a dividend of 15 per cent. was expected for the business year 1925. The stocks of the concern now amount to about 1,000,000 tons of pure potash and about 10,000 tons of potash in the form of raw salts. Of 89 works belonging to the concern only 10 were employed, owing to the concentration policy, which had also decreased costs by about 50 per cent. A general meeting, to be held next April, will decide on the cancellation of the preference shares of the Potash Industry Co., which belongs to the Wintershall concern—and which amount to approximately 80 per cent. of the total capital of the company.

References to Current Literature

British

ANALYSIS.—An electrolytic method for determination of zinc in zinc ores. R. E. Sullivan and H. S. Lukens. *Chem. News*, November 20, 1925, pp. 321–324.

COLLOIDS.—Determination of size of colloidal particles by means of alternating electric fields. E. F. Burton and B. M. Reid. *Phil. Mag.*, December, 1925, pp. 1221–1226.

CRYSTALLOGRAPHY.—The crystal structure of barytes, celestine and anglesite. R. W. James and W. A. Wood. *Roy. Soc. Proc.*, December, 1925, pp. 598–620.

HYDROLYSIS.—The effect of gum arabic and other emulsifiers on the acid hydrolysis of esters in heterogeneous systems. R. C. Smith. *Chem. Soc. Trans.*, November, 1925, pp. 2602–2605.

SMELL.—The relation between chemical constitution and pungency in acid amides. E. C. S. Jones and F. L. Pyman. *Chem. Soc. Trans.*, November, 1925, pp. 2588–2598.

SYSTEMS.—Equilibrium in the system: $CH_3.CO.O.CH_3 + H_2O \rightleftharpoons CH_3.OH + CH_3.CO.OH$. G. J. Burrows. *Chem. Soc. Trans.*, November, 1925, pp. 2723–2728.

Studies of equilibrium in systems of the type $Al_2(SO_4)_3 - M''SO_4 - H_2O$. Part II. Aluminium sulphate—nickel sulphate—water at 30°. R. M. Caven and T. C. Mitchell. *Chem. Soc. Trans.*, November, 1925, pp. 2549–2550.

TERPENES.—The occurrence of sylvestrene. B. S. Rao and J. L. Simonsen. *Chem. Soc. Trans.*, November, 1925, pp. 2494–2499.

Olefinic terpene ketones from the volatile oil of flowering *tagetes glandulifera*. Part I. T. G. H. Jones and F. B. Smith. *Chem. Soc. Trans.*, November, 1925, pp. 2530–2539.

United States

COLLOIDS.—Influence of adsorption on the colour of sols and of precipitates. N. R. Dhar. *J. Phys. Chem.*, November, 1925, pp. 1394–1399.

COMBUSTION.—Present status of the facts and theories of detonation. G. L. Clark and W. C. Thee. *J. Ind. Eng. Chem.*, December, 1925, pp. 1219–1226.

The mechanism of combustion in the Bunsen cone. E. W. Rembert and R. T. Haslam. *J. Ind. Eng. Chem.*, December, 1925, pp. 1233–1236.

Relative rates of combustion of constituents of city gas burning in secondary air. E. W. Rembert and R. T. Haslam. *J. Ind. Eng. Chem.*, December, 1925, pp. 1240–1242.

DYESTUFFS.—Comparative study of azo dyes made with H-acid and acetyl-H-acid. L. W. Lewers and A. Lowy. *J. Ind. Eng. Chem.*, December, 1925, pp. 1289–1290.

NITROGEN FIXATION.—The fixation of atmospheric nitrogen by yeast as a function of the hydrogen ion concentration. E. I. Fulmer and L. M. Christensen. *J. Phys. Chem.*, November, 1925, pp. 1415–1418.

ORGANO-ARSENIC COMPOUNDS.—Future research in the field of organic arsenicals. W. G. Christiansen. *J. Ind. Eng. Chem.*, December, 1925, pp. 1270–1271.

French

BERYLLIUM.—Thermochemistry of beryllium. D. Matignon and G. Marchal. *Compt. rend.*, November 30, 1925, pp. 859–861.

The various states of beryllium oxide. H. Copaux and C. Matignon. *Bull. Soc. Chim.*, November, 1925, pp. 1359–1365.

COMPLEX COMPOUNDS.—Complex compounds of ruthenium chlorides. R. Charonnat. *Compt. rend.*, November 30, 1925, pp. 866–867.

CYCLO-HEXANE COMPOUNDS.—Geometric stereoisomerism in the cyclohexane series. Part I. *o*-Methyl-cyclohexanol. M. Godchot and P. Bedos. *Bull. Soc. Chim.*, November, 1925, pp. 1451-1466.

Monochloro-*o*-methylcyclohexanone. M. Godchot and P. Bedos. *Compt. rend.*, December 7, 1925, pp. 919–921.

DEHYDRATION.—Dehydration of aqueous alcohol by rectification in presence of benzene. J. Barbaudy. *Compt. rend.*, December 7, 1925, pp. 911–913.

DEHYDROGENATION.—The preparation of isonuclear bromo-nitro-naphthalenes by dehydrogenation of the corresponding derivatives of tetralin. V. Vesely and L. K. Chudozilov. *Bull. Soc. Chim.*, November, 1925, pp. 1436–1444.

FLUORINE.—A ready method for the preparation of fluorine. P. Lebeau and A. Damiens. *Compt. rend.*, December 7, 1925, pp. 917–919.

NICOTINE.—Rotatory dispersion of nicotine. T. M. Lowry and B. K. Singh. *Compt. rend.*, December 7, 1925, pp. 909–911.

ORGANO-METALLIC COMPOUNDS.—Investigation of mixed organo-aluminium compounds. Aluminium monoethyl and diethyl iodides. V. Grignard and R. L. Jenkins. *Bull. Soc. Chim.*, November, 1925, pp. 1376–1385.

Synthesis of *p*-cymene compounds from isopropyl alcohol. Part II. By means of *p*-isopropylphenyl-magnesium bromide. L. Bert. *Bull. Soc. Chim.*, November, 1925, pp. 1397–1410.

German

ADDITION COMPOUNDS.—A new ammonium sulphate nitrate. L. Wöhler and W. Schäffer. *Z. anorg. u. allg. Chem.*, November 30, 1925, pp. 389–394.

AMMONIA.—The influence of steam and hydrochloric acid on the velocity of decomposition of ammonia. A. Schmidt. *Z. angew. Chem.*, December 10, 1925, pp. 1146–1154.

CARBON.—The application and revivification of decolourising carbon. Part I. B. Block. *Chem. Apparatus*, November 25, 1925, pp. 222–224.

CORROSION.—Rust-preventing means. J. Swoboda. *Chem.-Zeit.*; Part I, November 20, 1925, pp. 977–979; Part II, November 26, 1925, pp. 994–997.

CYANAMIDE.—The chemistry of calcium cyanamide. Part I. H. H. Franck and F. Hochwald. *Z. Elektrochem.*, November, 1925, pp. 581–590.

DRYING.—The drying industry. Part IV. M. Winckel. *Chem.-Zeit.*, November 12, 1925, pp. 957–958.

GENERAL.—The high-molecular condition of carbohydrates and proteins and their synthesis. M. Bergmann. *Z. angew. Chem.*, December 10, 1925, pp. 1141–1144.

NITRO COMPOUNDS.—Aliphatic nitro-alcohols. E. Schmidt, A. Ascherl, and L. Mayer. *Ber.*, November 11, 1925, pp. 2430–2434.

PHENOLS.—The alkylation of phenols. M. Busch. *Z. angew. Chem.*, December 10, 1925, pp. 1145–1146.

PLATINUM METALS.—The separation of the platinum metals. L. Wöhler and L. Metz. *Z. anorg. u. allg. Chem.*, November 30, 1925, pp. 297–323.

The binary bromides and iodides of platinum. L. Wöhler and F. Müller. *Z. anorg. u. allg. Chem.*, November 30, 1925, pp. 377–386.

Formation and decomposition of the sodium complexes of platinum and iridium chlorides. L. Wöhler and P. Balz. *Z. anorg. u. allg. Chem.*, November 30, 1925, pp. 353–358.

REFRACTORIES.—Investigation of fireproof materials and other aluminiferous substances. E. Schürmann and W. Böhm. *Chem.-Zeit.*; Part I, November 5, 1925, pp. 933–934; Part II, November 12, 1925, pp. 958–959.

Miscellaneous

ADDITION COMPOUNDS.—An addition product of mandelic acid and benzene. C. W. Zahn. *Rec. Trav. Chim., Pays-Bas*, November, 1925, pp. 1048–1050.

ANALYSIS.—Methods for the estimation of volatile matter in coal. S. de Waard. *Chem. Weekblad*, October 31, 1925, pp. 525–530.

PHENOLATES.—The formation of phenolates using metals. F. Zetzsche, H. Silbermann and G. Vieli. *Helv. Chim. Acta*, October 1, 1925, pp. 596–602.

REACTIONS.—Study of the reaction of nitriles on organo-magnesium compounds. L. Mathus. *Bull. Soc. Chim. Belg.*, 1925, pp. 285–289.

SPECTROSCOPY.—Ultraviolet adsorption spectra of butene nitriles and the corresponding acids. P. Bruylants and A. Castille. *Bull. Soc. Chim. Belg.*, 1925, pp. 261–284.

Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each

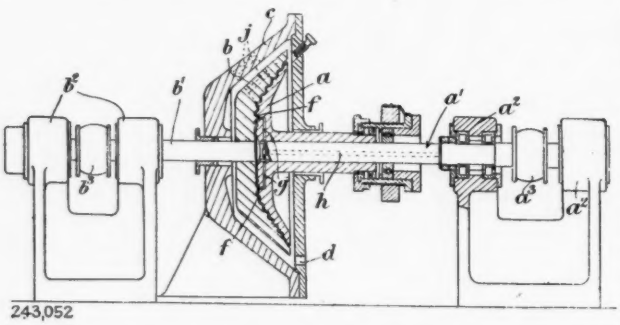
Abstracts of Complete Specifications

243,046. Solutions containing Oxides of Chromium, Production of, and the Electrolytic Separation of Chromium from such Solutions. E. Liebreich, 51, Joachim-Friedrichstrasse, Berlin-Halensee. Application date, August 13, 1924.

These solutions are colloidal, or partly colloidal aqueous solutions containing divalent or trivalent oxides of chromium, and are suitable for the electrolytic separation of chromium. Chromium trioxide, CrO_3, is melted at a temperature at which oxygen is given off, and reduction takes place. Air is excluded and agitation is avoided. The chromium trioxide should contain less than 1·2 per cent. of free sulphuric acid, and no other impurities. The heating is discontinued before excessive reduction causes the mass to solidify.

243,052. Colloid Mills, and Drying, Concentrating, Mixing, Grinding, Emulsifying, and Like Machines. Rissik, Fraser and Co., Ltd., and A. Fraser, of R. and F. Works, Factory Lane, Croydon, Surrey. Application date, August 16, 1924.

This colloid mill enables a solid or liquid material to be introduced at an intermediate point between the central inlet and peripheral outlet. The two rotary discs *a*, *b* are carried on co-axial shafts a^1, b^1, having driving pulleys a^3, b^3. The discs are dished and their opposed faces are corrugated concentrically, and they are enclosed in a stationary casing *c*. The shaft a^1 is hollow and constitutes the main inlet conduit, through which material is fed to the space between the discs. The emulsified material is discharged through an outlet *d*. A pipe *h* is arranged centrally within the shaft a^1 and communicates with passages *g* in the disc *a*. Material may thus



243,052

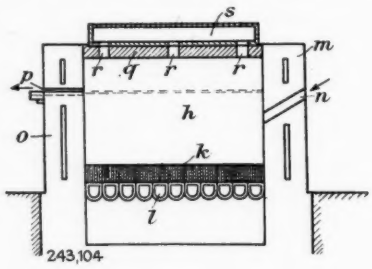
be supplied through this pipe to a point *f* intermediate between the inlet and outlet of the grinding space. The discs may be formed with teeth near their centre so that coarse material may be ground before mixing with the material supplied through the pipe *h*. An alternative or additional inlet may extend through the shaft b^1 and disc *b*.

243,081. Titanium Pigments and Process of Preparation Thereof. C. A. Klein, 4, Brimsdown Avenue, Brimsdown, Middlesex, and R. S. Brown, 36, Manor House, Marylebone Road, London. Application date, August 25, 1924.

This titanium pigment has a basis of barium sulphate. Barium carbonate is fused with rutile or ilmenite, with or without a flux such as fluorspar, and a reducing agent to obtain a slag of barium and titanium oxides and metallic iron. If barium sulphate is used instead of carbonate, the heating liberates sulphuric acid, which may be recovered for use at a later stage in the process. A mixture of barium, titanium, and iron oxides is obtained, and is fused with carbon to reduce the iron oxide to metallic iron. Most of the iron is removed in any suitable manner, and the remainder separated magnetically after crushing the slag. Sulphuric acid is then added to obtain barium and titanium sulphates, which are ground and added to boiling water in the presence of organic material such as aldehydes, sugar, or starch, to prevent the precipitation of traces of iron. The titanium compounds are thus precipitated on to the barium sulphate, and the product is washed, dried, and roasted at 900° C. to burn off any carbon. The product is ground, yielding a white pigment.

243,104. Alkali Chlorides, Process and Apparatus for Decomposing by Steam in the Presence of Silicates. J. Kersten, 64, Schönebergerstrasse, Bensheim au du Bergstrasse, Germany. Application date, September 8, 1924.

A mixture of alkali chloride and alkali silicate is fused, mixed with carbon and highly superheated steam, and air injected into the mixture. Some of the carbon is burned thus liberating heat, and part of the carbon is decomposed



243,104

by the steam, hydrogen being liberated. The heat liberated should be sufficient to decompose the alkali chloride and maintain the temperature. The liberated hydrogen decomposes the chloride more readily than the steam, forming hydrochloric acid, and alkali metal, which reacts with more steam, forming alkali oxide and hydrogen. The alkali oxide combines with the silicate to form an alkali salt. Alternatively, the heating by the internal combustion of carbon may be replaced by external heating.

The operation may be carried out intermittently by melting the alkali chloride and silicate in separate ovens, mixing them in a converter with carbon, and then treating with steam and air. A furnace suitable for continuous working comprises a chamber *h* having a grate *k* through which steam and air are injected from passages *l*. The end wall *m* of the furnace contains an inclined channel *n* through which the previously melted salts are introduced continuously. A horizontal channel *p* is provided in the opposite wall *o* at a slightly higher level, through which the treated material is continuously discharged. Hydrochloric acid gas passes through ports *r* into a collector *s*.

243,115. Azo Colouring Matters Dyeing wool fast to Milling. British Dyestuffs Corporation, Ltd., J. Baddiley, J. Hill, and A. Riley, 70, Spring Gardens, Manchester. Application date, September 17, 1924.

These azo colouring matters are obtained by preparing a diazotisable compound by treating at least one molecular proportion of formaldehyde with one molecular proportion of an amine in the form of its hydrochloride. This is diazotised and combined with sulphonated azo dye components such as sulphonated pyrazolones, and naphthylamine, naphthol, and amino-naphthol sulpho acids. In an example, aniline is dissolved in water and hydrochloric acid so that the solution is slightly acid. Formaldehyde solution is then added, and the product may be used as such or the base may be precipitated by adding an excess of alkali and subsequently employed in hydrochloric acid solution. This solution is mixed with hydrochloric acid and diazotised, and poured into a solution of 1-*p*-sulphophenyl-3-methyl-5-pyrazolone. The dyestuff gives yellow shades on wool. Other similar bases derived from other primary amines may be used.

243,122. NITROGEN-HYDROGEN MIXTURES FOR AMMONIA SYNTHESIS, PRODUCTION OF. H. A. Humphrey, Norton Hardwick, Stockton-on-Tees, and Synthetic Ammonia and Nitrates, Ltd., Billingham, Stockton-on-Tees. Application date, September 24, 1924.

In the manufacture of nitrogen-hydrogen mixtures from water gas or producer gas, the resulting mixture contains 1–3 per cent. of methane after purifying from water vapour, carbon monoxide, and carbon dioxide. This inert constituent increases in proportion during successive passages of the gas over the catalyst, and involves periodical waste of the gases. In this invention, a nitrogen-hydrogen mixture containing little or no methane is obtained from carbonaceous fuel. Fuel is pulverised and burned with highly heated air and steam at a very high temperature—*e.g.*, 1300° C.—and under these conditions the resulting gas contains no methane or other inert hydrocarbons. This result is not obtained in an ordinary producer, even though it may contain a hot zone at 1300° C. In this invention, the whole of the combustion chamber is at the same high temperature, and the hydrocarbons are completely cracked. The combustion gases are mixed with steam and passed over a contact mass of iron oxide at a temperature of 500° C., when the carbon monoxide is converted into dioxide and hydrogen. The carbon dioxide, excess steam, and residual carbon monoxide are then removed, leaving a nitrogen-hydrogen mixture which is adjusted to the required proportion by adding additional hydrogen. If sufficient hydrogen is used in the initial production of the gaseous mixture, it may not be necessary to add hydrogen to the final nitrogen-hydrogen mixture.

243,123. ADSORPTIVE SILICEOUS MATERIAL, METHOD OF PREPARING. F. X. Govers, 588, West End Avenue, Manhattan, New York. Application date, September 25, 1924.

In the method of preparing colloidal silicic acid, hydrochloric acid is added to sodium silicate solution. A sol is obtained which subsequently sets in a gel form, the latter being used in the production of adsorptive material. In the present invention the adsorptive material is prepared from the sol and not from the gel. A solution of sodium silicate having a density of 1·16–1·12 is treated with an equal volume of hydrochloric acid varying from 0·55 normal to 4·0 normal, at any temperature from 0° to 100° C. A sol is obtained, the setting of which is retarded for 1–3 hours, and it must be dried before a gel has formed or set. This is effected by spraying the solution into a heated chamber in which the water is evaporated and the solids settle in finely divided form. The product is washed and dried again, and has greater adsorptive and clarifying powers than the product obtained from silicic acid which has been allowed to set to a gel.

NOTE.—Abstracts of the following specifications which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention :—224,522 (Farbwerke vorm. Meister, Lucius, and Brüning), relating to manufacture of 2^1-oxybenzanthrone, see Vol. XII, p. 60 ; 229,623 (Chemische Fabrik Pyrgos Ges. and R. Haller), relating to manufacture of soluble starch products, see Vol. XII, p. 440 ; 231,147 (Salzwerk Heilbronn Akt.-Ges., T. Lichtenberger and K. Flor), relating to decomposition of alkali chlorides, see Vol. XII, p. 537 ; 231,886 (Farbenfabriken vorm. F. Bayer and Co.), relating to manufacture of ortho-acetoxy-paramethoxy-benzoic acid, see Vol. XII, p. 616 ; 232,549 (T. R. Haglund), relating to treatment of raw materials containing highly refractory oxide, see Vol. XII, p. 641 ; 235,552 (Continental Akt.-Ges. für Chemie), relating to production of ammonium chloride and alkali sulphate, see Vol. XIII, p. 176 ; 237,567, relating to preliminary treatment of cellulose prior to esterification, see Vol. XIII, p. 333.

International Specifications not yet Accepted

241,572. DYES. Soc. of Chemical Industry in Basle, Switzerland. International Convention date, October 16, 1924.

Nitrated diazotised 1-amino-2-oxynaphthalene-4-sulphonic acid is coupled with α- or β-naphthol, reduced, and converted into soluble zinc compounds by treating with zinc chloride dissolved in caustic alkali, or ammoniacal zinc chloride or hydroxide. These dyes give violet to brown-black shades on wool.

241,579 and 241,580. SULPHO-HALOGENAMIDES. Farbenfabriken vorm. F. Bayer and Co., Leverkusen, near Cologne, Germany. International Convention date, October 18, 1924.

241,579. In an example of the production of alkali salts of aromatic sulpho-chloramides an aqueous solution of *p*-toluene sulphonamide, bleaching powder and calcined sodium carbonate, are heated and the precipitated calcium carbonate separated. Sodium *p*-toluene sulpho-chloramide crystallises on cooling.

241,580. A sulphonamide or a salt thereof is mixed with a hypochlorite to obtain a stable product for bleaching, disinfecting, etc., which yields salts of sulpho-chloramides when added to water. The mixture may be treated with a salt to precipitate the metal of the hypochlorite, and so avoid the production of an insoluble soap when employed for washing. Thus, *p*-toluene sulphonamide and bleaching powder may be employed, with or without the addition of soda to precipitate the calcium.

241,851. HYPOCHLORITES. Raduner and Co., Akt.-Ges., Horn, Thurgau, Switzerland. International Convention date, October 21, 1924.

Apparatus employed in processes in which chloride of lime or other hypochlorites are used, is made of aluminium.

241,889. HYDROLYSIS OF ESTERS. E. E. Ayres and E. H. Haabestad, c/o Sharples Specialty Co., 23rd Street, Philadelphia, U.S.A. International Convention date, October 21, 1924.

Esters of inorganic acids are hydrolysed by heating with aqueous alkali solution in the presence of the same ester of a water-insoluble fatty acid or its sulphonic derivatives. In an example, amyl chloride, caustic soda solution, and amyl oleate are heated together. The amyl chloride is obtained by chlorinating pentane or a gasoline fraction of 20°–40° C. boiling point, and the amyl oleate is obtained by heating amyl chloride with oleic acid and caustic soda. The product is steam-distilled to separate the amyl alcohol from amyl oleate, dihydroxy pentane being a by-product. Olefines are not formed owing to the moderate temperature, and absence of high pressure and agitation. Halogen derivatives of fatty and aromatic hydrocarbons, and mercaptans and organic sulphides may be similarly treated.

241,903. PHOSPHORIC ACID. Chemische Fabrik Griesheim-Elektron, 31, Gutleutstrasse, Frankfort-on-Main, Germany. International Convention date, October 23, 1924.

The hot gases obtained by burning phosphorus are passed into a packed tower through which water or dilute phosphoric acid solution trickles, and the phosphorus pentoxide is thus condensed in hot water.

Specifications Accepted with Date of Application

224,521. Highly active charcoal in grains, Process for making. Ges. für Chemische Produktion, H. Müller-Clemm, and I. Schmidt. November 5, 1923.

231,805, 6, 8. Artificial materials, Manufacture of. L. Lilienfeld. April 4, 1924.

232,612. Organic arsenic compounds, Process for the manufacture of. F. Lehnhoff-Wyld. April 17, 1924.

243,505. Dyestuff intermediates, Production of. J. Thomas, and Scottish Dyes, Ltd. July 2, 1924.

243,857. Distillation of carbonaceous materials. B. Laing and H. Nielsen. October 10, 1924.

243,892. Alloys, Manufacture of. H. Wade. (International Nickel Co.). November 21, 1924.

243,925. N-methylsulphites of secondary aromatic aliphatic amines, Manufacture of. Farbwerke vorm. Meister, Lucius, and Brüning, N. Bockmuhl, and A. Schwarz. January 24, 1925. Addition to 164,002.

243,929. Clay, Treatment of. T. W. Parker. February 5, 1925.

243,942. Retorts for the destructive distillation or heat-treatment of solid materials. A. L. J. Queneau. February 23, 1925.

243,946. Treating substances centrifugally, Method of, and machines for. A. E. White. (*Sharples Specialty Co.*). February 24, 1925.

243,978. Anhydrous magnesium chloride, Method of producing. C. Arnold. (*Dow Chemical Co.*). April 27, 1925.

243,982. Evaporating solutions in vacuo, Method of. Naamlooze Vennootschap Nederlandsche Installatie Maatschappij Therma and A. O. H. Petersen. May 1, 1925.

243,990. Soluble carbonates and hydrates, Process of producing. A. F. Meyerhofer. July 24, 1924. Addition to 219,971.

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£20 per ton.
ACID BORIC, COMMERCIAL.—Crystal, £40 per ton, Powder, £42 per ton.
ACID HYDROCHLORIC.—3s. 9d. to 6s. per carboy d/d, according to purity, strength, and locality.
ACID NITRIC, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.
ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations; 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
AMMONIA ALKALI.—£6 15s. per ton f.o.r. Special terms for contracts.
BLEACHING POWDER.—Spot, £10 10s. d/d; Contract, £8 10s. d/d, 4-ton lots.
BISULPHITE OF LIME.—£7 10s. per ton, packages extra, returnable.
BORAX, COMMERCIAL.—Crystal, £25 per ton. Powder, £26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain.)
CALCIUM CHLORATE (SOLID).—£5 12s. 6d. to £5 17s. 6d. per ton d/d, carr. paid.
COPPER SULPHATE.—£25 to £25 10s. per ton.
METHYLATED SPIRIT 64 O.P.—Industrial, 2s. 5d. to 2s. 11d. per gall. Mineralised, 3s. 8d. to 4s. per gall., in each case according to quantity.
NICKEL SULPHATE.—£38 per ton d/d.
NICKEL AMMONIA SULPHATE.—£38 per ton d/d.
POTASH CAUSTIC.—£30 to £33 per ton.
POTASSIUM BICHROMATE.—4½d. per lb.
POTASSIUM CHLORATE.—3⅞d. per lb., ex wharf, London, in cwt. kegs.
SALAMMONIAC.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.
SALT CAKE.—£3 15s. to £4 per ton d/d. In bulk.
SODA CAUSTIC, SOLID.—Spot lots delivered, £15 12s. 6d. to £18 per ton, according to strength; 30s. less for contracts.
SODA CRYSTALS.—£5 to £5 5s. per ton ex railway depots or ports.
SODIUM ACETATE 97/98%.—£21 per ton.
SODIUM BICARBONATE.—£10 10s. per ton, carr. paid.
SODIUM BICHROMATE.—3½d. per lb.
SODIUM BISULPHITE POWDER 60/62%.—£17 per ton for home market, 1-cwt. iron drums included.
SODIUM CHLORATE.—3d. per lb.
SODIUM NITRATE, REFINED 96%.—£13 5s. to £13 10s. per ton, ex Liverpool.
SODIUM NITRITE, 100% BASIS.—£27 per ton d/d.
SODIUM PHOSPHATE.—£14 per ton, f.o.r. London, casks free.
SODIUM SULPHATE (GLAUBER SALTS).—£3 12s. 6d. per ton.
SODIUM SULPHIDE CONC. SOLID, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.
SODIUM SULPHIDE CRYSTALS.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.
SODIUM SULPHITE, PEA CRYSTALS.—£14 per ton f.o.r. London, 1-cwt. kegs included.

Coal Tar Products

ACID CARBOLIC CRYSTALS.—4⅜d. to 4¾d. per lb. Crude 60's, 1s. 4d. Little demand.
ACID CRESYLIC 97/99.—1s. 7d. to 1s. 9d. per gall. Pale, 95%, 1s. 5d. to 1s. 9d. per gall. Dark, 1s. 4d. to 1s. 6d. per gall. Good demand.
ANTHRACENE PASTE 40%.—3d. per unit per cwt.—Nominal price. No business.
ANTHRACENE OIL, STRAINED.—8d. per gall. Good inquiry. Unstrained, 7d. per gall.
BENZOL.—Crude 65's, 1s. 2d. to 1s. 3d. per gall., ex works in tank wagons. Standard Motor, 1s. 8d. to 1s. 10d. per gall., ex works in tank wagons. Pure, 1s. 11d. to 2s. 3d. per gall., ex works in tank wagons.
TOLUOL.—90%, 1s. 8½d. per gall. More inquiry. Pure, 1s. 11d. to 2s. 2d. per gall.
XYLOL COMMERCIAL.—1s. 10d. to 2s. 3d. per gall. Pure, 2s. 1d. to 3s. 3d. per gall.
CREOSOTE.—Cresylic, 20/24%, 8½d. per gall. Market very quiet. Standard specification, 7d. to 7¼d. per gall.; middle oil, heavy, 6¾d. per gall. Market steady.
NAPHTHA.—Crude 9½d. per gall. Solvent 90/160, 1s. 5d. to 1s. 11d. per gall. Fair business. Solvent 90/190, 1s. 2d. to 1s. 6d per gall. Moderate demand.
NAPHTHALENE CRUDE.—Drained Creosote Salts, £3 to £5 per ton. Whizzed or hot pressed, £5 10s. to £6.
NAPHTHALENE.—Crystals and Flaked, £12 to £13 per ton, according to districts.
PITCH.—Medium soft, 45s. to 55s. per ton, according to district. Market active.
PYRIDINE.—90/160, 17s. 6d. to 20s. per gall. Firmer. Heavy, 10s. 6d. to 11s. per gall. More inquiry.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated.

ACETIC ANHYDRIDE 95%.—1s. 7d. per lb.
ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.
ACID ANTHRANILIC.—7s. per lb. 100%.
ACID BENZOIC.—1s. 9d. per lb.
ACID GAMMA.—9s. per lb.
ACID H.—3s. 6d. per lb. 100% basis d/d.
ACID NAPHTHIONIC.—2s. 2d. per lb. 100% basis d/d.
ACID NEVILLE AND WINTHER.—4s. 9d. to 4s. 10d. per lb. 100% basis d/d.
ACID SULPHANILIC.—9d. per lb. 100% basis d/d.
ALUMINIUM CHLORIDE, ANHYDROUS.—10d. per lb. d/d.
ANILINE OIL.—7d. to 7¼d. per lb. naked at works.
ANILINE SALTS.—7d. to 8d. per lb. naked at works.
ANTIMONY PENTACHLORIDE.—1s. per lb. d/d.
BENZALDEHYDE.—2s. 1½d. per lb. Good home inquiry.
BENZIDINE BASE.—3s. 6d. per lb. 100% basis d/d.
BENZYL CHLORIDE 95%.—1s. 1d. per lb.
p-CHLORPHENOL.—4s. 3d. per lb. d/d.
p-CHLORANILINE.—3s. per lb. 100% basis.
o-CRESOL 29/31° C.—3d. per lb. Demand quiet.
m-CRESOL 98/100%.—2s. 1d. to 2s. 3d. per lb. Demand moderate.
p-CRESOL 32/34° C.—2s. 1d. to 2s. 3d. per lb. Demand moderate.
DICHLORANILINE.—2s. 3d. per lb.
DICHLORANILINE S. ACID.—2s. 3d. per lb. 100% basis.
DIETHYLANILINE.—4s. 3d. per lb. d/d., packages extra, returnable.
DIMETHYLANILINE.—2s. per lb. d/d. Drums extra.
DINITROBENZENE.—9d. per lb. naked at works.
DINITROCHLORBENZENE.—£84 per ton d/d.
DINITROTOLUENE.—48/50° C. 8d. to 9d. per lb. naked at works. 66/68° C. 10d. per lb. naked at works.
DIPHENYLANILINE.—2s. 10d. per lb. d/d.
G. SALT.—2s. 2d. per lb. 100% basis d/d.
a-NAPHTHOL.—2s. per lb. d/d. Fair home inquiry.
B-NAPHTHOL.—11d. to 1s. per lb. d/d. Fair home inquiry.
a-NAPHTHYLAMINE.—1s. 3d. per lb. d/d. Fair home inquiry.
B-NAPHTHYLAMINE.—3s. 9d. per lb. d/d. Fair home inquiry.
o-NITRANILINE.—5s. 9d. per lb.
m-NITRANILINE.—3s. 6d. per lb. d/d.
p-NITRANILINE.—1s. 10d. per lb. d/d. Fair home inquiry.
NITROBENZENE.—5¼d. per lb. naked at works. Good home inquiry.
o-NITROCHLORBENZOL.—2s. 3d. per lb. 100% basis d/d.
NITRONAPHTHALENE.—10d. per lb. d/d.
p-NITROPHENOL.—1s. 9d. per lb. 100% basis d/d.
p-NITRO-*o*-AMIDO-PHENOL.—4s. 6d. per lb. 100% basis.
m-PHENYLENE DIAMINE.—4s. per lb. d/d.
p-PHENYLENE DIAMINE.—9s. 9d. per lb. 100% basis d/d.
R. SALT.—2s. 4d. per lb. 100% basis d/d.
SODIUM NAPHTHIONATE.—1s. 9d. per lb. 100% basis d/d.
o-TOLUIDINE.—9d. per lb. Good home inquiry.
p-TOLUIDINE.—2s. 3d. per lb. naked at works.
m-TOLUYLENE DIAMINE.—4s. per lb. d/d.
m-XYLIDINE ACETATE.—2s. 11d. per lb. 100%.

Wood Distillation Products

ACETATE OF LIME.—Brown, £8. Quiet market. Grey, £14 10s. per ton. Liquor, 9d. per gall. 32° Tw.
ACETONE.—£73 per ton.
CHARCOAL.—£7 to £9 per ton, according to grade and locality. Demand fair.
IRON LIQUOR.—1s. 7d. per gall. 32° Tw. 1s. 2d. per gall., 24° Tw.
RED LIQUOR.—10d. to 1s. per gall. 15° Tw.
WOOD CREOSOTE.—2s. 7d. per gall. Unrefined.
WOOD NAPHTHA, MISCIBLE.—5s. per gall. 60% O.P. Solvent, 4s. 6d. per gall. 40% O.P. Very quiet.
WOOD TAR.—£3 15s. to £5 per ton, according to grade.
BROWN SUGAR OF LEAD.—£40 per ton.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 7¼d. to 1s. 5d. per lb., according to quality, Crimson, 1s. 5d. to 1s. 7½d. per lb., according to quality.
ARSENIC SULPHIDE, YELLOW.—2s. per lb.
BARYTES.—£3 10s. to £6 15s. per ton, according to quality.
CADMIUM SULPHIDE.—4s. 4d. per lb.
CARBON BISULPHIDE.—£25 to £28 per ton, according to quantity.
CARBON BLACK.—5½d. per lb., ex wharf.
CARBON TETRACHLORIDE.—£55 to £60 per ton, according to quantity, drums extra.
CHROMIUM OXIDE, GREEN.—1s. 3d. per lb.
DIPHENYLGUANIDINE.—4s. to 4s. 3d. per lb.
INDIARUBBER SUBSTITUTES, WHITE AND DARK.—5¾d. to 6¾d. per lb.
LAMP BLACK.—£43 per ton, barrels free.

LEAD HYPOSULPHITE.—9d. per lb.
LITHOPONE, 30%.—£22 10s. per ton.
MINERAL RUBBER "RUBPRON."—£13 12s. 6d. per ton f.o.r. London.
SULPHUR.—£9 to £11 per ton, according to quality.
SULPHUR CHLORIDE.—4d. per lb., carboys extra.
SULPHUR PRECIP. B.P.—£50 to £55 per ton.
THIOCARBAMIDE.—2s. 6d. to 2s. 9d. per lb.
THIOCARBANILIDE.—2s. 1d. to 2s. 3d. per lb.
VERMILION, PALE OR DEEP.—5s. per lb.
ZINC SULPHIDE.—1s. 1d. per lb.

Pharmaceutical and Photographic Chemicals

ACID, ACETIC, 80% B.P.—£39 per ton ex wharf London in glass containers.
ACID, ACETYL SALICYLIC.—2s. 5d. to 2s. 7d. per lb. Keen competition continuing. Good demand.
ACID, BENZOIC B.P.—2s. to 2s. 3d. per lb., according to quantity.
ACID, BORIC B.P.—Crystal, £46 per ton; Powder, £50 per ton. Carriage paid any station in Great Britain.
ACID, CAMPHORIC.—19s. to 21s. per lb.
ACID, CITRIC.—1s. 4d. per lb., less 5%. Unsettled.
ACID, GALLIC.—2s. 8d. per lb. for pure crystal, in cwt. lots.
ACID, PYROGALLIC, CRYSTALS.—5s. 3d. per lb. Resublimed, 7s. 6d.
ACID, SALICYLIC.—1s. 2½d. to 1s. 5d. per lb. Technical.—10½d. to 11d. per lb.
ACID, TANNIC B.P.—2s. 10d. per lb.
ACID, TARTARIC.—1s. 0½d. per lb., less 5%. Market firm.
AMIDOL.—6s. 6d. per lb., d/d.
ACETANILIDE.—1s. 7d. to 1s. 8d. per lb. for quantities.
AMIDOPYRIN.—12s. 6d. per lb.
AMMONIUM BENZOATE.—3s. 3d. to 3s. 6d. per lb., according to quantity.
AMMONIUM CARBONATE B.P.—£37 per ton. Powder, £39 per ton in 5 cwt. casks.
ATROPINE SULPHATE.—11s. per oz. for English make.
BARBITONE.—10s. per lb.
BENZONAPHTHOL.—3s. 3d. per lb. spot.
BISMUTH CARBONATE.—15s. 6d. to 17s. 6d. per lb.
BISMUTH CITRATE.—12s. 9d. to 14s. 9d. per lb.
BISMUTH SALICYLATE.—12s. 6d. to 14s. 6d. per lb.
BISMUTH SUBNITRATE.—13s. to 15s. per lb. according to quantity.
BORAX B.P.—Crystal, £29; Powder, £30 per ton. Carriage paid any station in Great Britain.
BROMIDES.—Potassium, 1s. 9d. to 1s. 11d. per lb.; sodium, 2s. to 2s. 2d. per lb.; ammonium, 2s. 3d. to 2s. 5d. per lb., all spot.
CALCIUM LACTATE.—1s. 4d. to 1s. 5d. Market firmer.
CHLORAL HYDRATE.—3s. 5d. to 3s. 6d. per lb., duty paid.
CHLOROFORM.—2s. 3d. to 2s. 7½d. per lb., according to quantity.
CREOSOTE CARBONATE.—6s. per lb.
FORMALDEHYDE.—£41 per ton, in barrels ex wharf.
GLYCEROPHOSPHATES.—Fair business passing. Calcium, soluble and citrate free, 7s. per lb.; iron, 8s. 9d. per lb.; magnesium, 9s. per lb.; potassium, 50%, 3s. 6d. per lb.; sodium, 60%, 2s. 6d. per lb.
GUAIACOL CARBONATE.—7s. per lb. Advanced.
HEXAMINE.—2s. 4d. to 2s. 6d. per lb.
HOMATROPINE HYDROBROMIDE.—30s. per oz.
HYDRASTINE HYDROCHLORIDE.—English make offered at 120s. per oz.
HYDROGEN PEROXIDE (12 VOLS.).—1s. 8d. per gallon f.o.r. makers' works, naked.
HYDROQUINONE.—4s. 4¾d. per lb., in cwt. lots.
HYPOPHOSPHITES.—Calcium, 3s. 6d. per lb., for 28-lb. lots; potassium, 4s. 1d. per lb.; sodium, 4s. per lb.
IRON AMMONIUM CITRATE B.P.—2s. to 2s. 3d. per lb. Green, 2s. 4d. to 2s. 9d. per lb. U.S.P., 1s. 11d. to 2s. 2d. per lb.
MAGNESIUM CARBONATE.—Light Commercial, £33 per ton net.
MAGNESIUM OXIDE.—Light Commercial, £70 per ton, less 2½ %, price reduced; Heavy Commercial, reduced to £23 per ton, less 2½% ; Heavy Pure, 2s. to 2s. 3d. per lb., according to quantity.
MENTHOL.—A.B.R. recrystallised B.P., 33s. net per lb., December delivery. Synthetic, 22s. 6d. to 27s. 6d. per lb., according to quality. English make. Very heavy demand.
MERCURIALS.—Red oxide, 5s. 2d. to 5s. 4d. per lb.; Corrosive sublimate, 3s. 9d. to 3s. 11d. per lb.; white precipitate, 4s. 6d. to 4s. 8d. per lb.; Calomel, 4s. to 4s. 2d. per lb. Market flat.
METHYL SALICYLATE.—1s. 6½d. to 1s. 7½d. per lb.
METHYL SULPHONAL.—16s. 9d. per lb.
METOL —9s. per lb. British make.
PARAFORMALDEHYDE.—1s. 11d. for 100% powder.
PARALDEHYDE.—1s. 4d. per lb.
PHENACETIN.—4s. to 4s. 3d. per lb.
PHENAZONE.—6s. to 6s. 3d. per lb. Spot lower than forward price.
PHENOLPHTHALEIN.—4s. to 4s. 3d. per lb. Supply exceeds demand.
POTASSIUM BITARTRATE 99/100% (Cream of Tartar).—80s. per cwt., less 2½% for ton lots. Market very firm.
POTASSIUM CITRATE.—1s. 11d. to 2s. 2d. per lb.
POTASSIUM FERRICYANIDE.—1s. 9d. per lb. in cwt. lots. Quiet.
POTASSIUM IODIDE.—16s. 8d. to 17s. 2d. per lb., according to quantity. Steady market.
POTASSIUM METABISULPHITE.—7½d. per lb., 1-cwt. kegs included, f.o.r. London.
POTASSIUM PERMANGANATE.—B.P. crystals, 7½d. per lb., spot. slightly easier.
QUININE SULPHATE.—2s. 3d. to 2s. 4d. per oz., in 100 oz. tins. Steady market.
RESORCIN.—3s. 9d. per lb. In fair quantities.
SACCHARIN.—51s. 5d. to 53s. 8d. per lb., according to quantity. Limited inquiry.
SALOL.—3s. per lb.
SILVER PROTEINATE.—12s. per lb. for satisfactory product light in colour.
SODIUM BENZOATE, B.P.—1s. 10d. to 2s. 2d. per lb.
SODIUM CITRATE, B.P.C., 1911.—1s. 8d. to 1s. 11d. per lb., B.P.C., 1923. 1s. 11d. to 2s. 2d. per lb., according to quantity. Advanced.
SODIUM HYPOSULPHITE, PHOTOGRAPHIC.—£14 to £15 per ton, according to quantity, d/d consignee's station in 1-cwt. kegs.
SODIUM METABISULPHITE CRYSTALS.—37s. 6d. to 60s. per cwt., net cash, according to quantity.
SODIUM NITROPRUSSIDE.—16s. per lb.
SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—75s. to 80s. per cwt., according to quantity.
SODIUM SALICYLATE.—Powder, 1s. 10d. to 2s. per lb. Crystal, 1s. 11d. to 2s. 1d. per lb. Very heavy demand.
SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 2d. per lb.
SODIUM SULPHITE, ANHYDROUS, £27 10s. to £28 10s. per ton, according to quantity; 1-cwt. kegs included.
SULPHONAL.—12s. per lb. Limited demand.
THYMOL.—12s. to 15s. per lb. Strong demand.

Perfumery Chemicals

ACETOPHENONE.—9s. per lb.
AUBEPINE (EX ANETHOL).—10s. 3d. per lb.
AMYL ACETATE.—3s. per lb.
AMYL BUTYRATE.—6s. 6d. per lb.
AMYL SALICYLATE.—3s. per lb.
ANETHOL (M.P. 21/22° C.).—6s. per lb.
BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—2s. 4d. per lb.
BENZYL ALCOHOL FREE FROM CHLORINE.—2s. 4d. per lb.
BENZALDEHYDE FREE FROM CHLORINE.—2s. 9d. per lb.
BENZYL BENZOATE.—2s. 9d. per lb.
CINNAMIC ALDEHYDE NATURAL.—16s. 9d. per lb.
COUMARIN.—11s. 9d. per lb.
CITRONELLOL.—16s. per lb.
CITRAL.—9s. 6d. per lb.
ETHYL CINNAMATE.—9s. per lb.
ETHYL PHTHALATE.—3s. per lb.
EUGENOL.—10s. per lb.
GERANIOL (PALMAROSA).—22s. 6d. per lb.
GERANIOL.—8s. to 16s. per lb.
HELIOTROPINE.—6s. 3d. per lb.
ISO EUGENOL.—14s. 6d. per lb.
LINALOL EX BOIS DE ROSE.—18s. per lb.
LINALYL ACETATE.—18s. per lb.
METHYL ANTHRANILATE.—9s. 3d. per lb.
METHYL BENZOATE.—5s. per lb.
MUSK KETONE.—35s. per lb.
MUSK XYLOL.—5s. 9d. per lb.
NEROLIN.—4s. per lb.
PHENYL ETHYL ACETATE.—14s. per lb.
PHENYL ETHYL ALCOHOL.—11s. 6d. per lb.
RHODINOL.—36s. 6d. per lb.
SAFROL.—1s. 4d. per lb.
TERPINEOL.—1s. 6d. per lb.
VANILLIN.—21s. 6d. to 23s. 6d. per lb. Good demand.

Essential Oils

ALMOND OIL.—12s. 6d. per lb.
ANISE OIL.—3s. 9d. per lb.
BERGAMOT OIL.—28s. per lb.
BOURBON GERANIUM OIL.—13s. 3d. per lb.
CAMPHOR OIL.—60s. per cwt.
CANANGA OIL, JAVA.—11s. 3d. per lb.
CINNAMON OIL, LEAF.—5d. per oz.
CASSIA OIL, 80/85%.—11s. per lb.
CITRONELLA OIL.—Java, 85/90%, 3s. 6d. Ceylon, 2s. 4d. per lb.
CLOVE OIL.—7s. 3d. per lb.
EUCALYPTUS OIL, 70/75%.—1s. 10d. per lb.
LAVENDER OIL.—French 38/40%, Esters, 25s. 6d. per lb.
LEMON OIL.—7s. 6d. per lb.
LEMONGRASS OIL.—4s. 9d. per lb.
ORANGE OIL, SWEET.—11s. 6d. per lb.
OTTO OF ROSE OIL.—Bulgarian, 60s. per oz. Anatolian, 35s. per oz.
PALMA ROSA OIL.—13s. 6d. per lb.
PEPPERMINT OIL.—Wayne County, 125s. per lb. Japanese, 23s. 7d. per lb.
PETITGRAIN OIL.—9d. per lb.
SANDAL WOOD OIL.—Mysore, 26s. per lb. Australian, 18s. 6d. per lb.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.*

Glasgow, December 23, 1925.

BUSINESS in the heavy chemical market remains quiet. There will probably not be much movement until the beginning of the year. Prices for one or two continental chemicals are quoted rather higher, probably on account of the lack of transport facilities at present.

Industrial Chemicals

ACID ACETIC 98/100%.—In usual steady demand. Quoted £55 to £67 per ton, according to quality and packing, c.i.f. U.K. port. 80% pure, £40 to £41 per ton; 80% technical, £38 to £39 per ton, packed in casks, c.i.f. U.K. ports.

ACID BORIC.—Crystal, granulated, or small flaked, £40 per ton. Powdered, £42 per ton, packed in bags, carriage paid U.K. stations.

ACID CARBOLIC, ICE CRYSTALS.—Still in poor demand and quoted price lower at about 4¾d. per lb., delivered or f.o.b. U.K. ports.

ACID CITRIC, B.P. CRYSTALS.—Unchanged at about 1s. 3⅜d. per lb., less 5%, ex wharf, in moderate demand.

ACID FORMIC 85%.—Quoted £48 per ton ex wharf, early delivery.

ACID HYDROCHLORIC.—In little demand. Price 6s. 6d. per carboy, ex works.

ACID NITRIC 80°.—Remains unchanged at £23 5s. per ton ex station, full truck loads.

ACID OXALIC 98/100%.—Spot material quoted 3¾d. per lb. ex wharf. Could be obtained slightly cheaper for prompt shipment from the Continent.

ACID SULPHURIC.—144°, £3 12s. 6d. per ton; 168°, £7 per ton ex works, full truck loads. Dearsenicated quality, 20s. per ton more.

ACID TARTARIC, B.P. CRYSTALS.—Still in poor demand. Price nominally 11⅜d. per lb., less 5%, ex wharf.

ALUMINA SULPHATE, 17/18% IRON FREE.—On offer from the Continent at about £5 10s. per ton, c.i.f. U.K. ports. Spot material available at £6 5s. per ton ex store.

ALUM, LUMP POTASH.—Rather higher quotations from the Continent. Now quoted £8 per ton, c.i.f. U.K. ports. Spot material available at about £9 5s. per ton ex store. Powdered quality on offer from the Continent at about £7 10s. per ton, c.i.f. U.K. ports.

AMMONIA ANHYDROUS.—In moderate demand and price unchanged at 1s. 4½d. per lb., less 5%, ex station. Containers extra and returnable.

AMMONIA CARBONATE.—Lump, £37 per ton. Powdered, £39 per ton. Packed in 5 cwt. casks delivered U.K. ports.

AMMONIA LIQUID 880°.—In usual steady demand and price unchanged at 2½d. to 3d. per lb. delivered according to quantity.

AMMONIA MURIATE.—Grey galvanisers' crystals of British manufacture quoted £26 per ton to £27 per ton ex station. On offer from the Continent at about £22 10s. per ton, c.i.f. U.K. ports. Fine white crystals quoted £18 15s. per ton, c.i.f. U.K. ports, prompt shipment from the Continent.

ARSENIC, REFINED WHITE CORNISH.—Price remains unchanged at about £17 15s. per ton ex wharf. Prompt despatch from works. Spot material quoted £19 per ton ex store.

BARIUM CHLORIDE.—Large white crystals quoted £9 per ton ex store. Spot delivery. On offer from the Continent at about £7 15s. per ton, c.i.f. U.K. ports. Fine white crystals £7 5s. per ton, c.i.f. U.K. ports.

BLEACHING POWDER.—English material unchanged at £9 10s. per ton ex station. Contracts 20s. per ton less. On offer from the Continent at about £7 15s. per ton, c.i.f. U.K. ports.

BARYTES.—English material unchanged at £5 5s. per ton ex works. Continental quoted £5 per ton, c.i.f. U.K. ports.

BORAX.—Granulated, £24 10s. per ton; crystals, £25 per ton; powdered, £26 per ton. Carriage paid U.K. stations.

CALCIUM CHLORIDE.—English manufacturers' price unchanged at £5 12s. 6d. to £5 17s. 6d. per ton carriage paid U.K. stations. Continental quoted £3 10s. per ton, c.i.f. U.K. ports.

COPPERAS, GREEN.—In good demand for export. Price unchanged at about £3 7s. 6d. per ton f.o.b. U.K. ports, packed in casks.

COPPER SULPHATE.—English material for export quoted £24 per ton, f.o.b. U.K. port. Continental on offer at about £22 per ton ex wharf.

FORMALDEHYDE 40%.—Spot material on offer at £40 per ton ex store. Quoted £38 per, ton c.i.f. U.K. ports, prompt shipment.

GLAUBER SALTS.—English material unchanged at £4 per ton ex store or station. Continental on offer at about £3 per ton, c.i.f. U.K. ports.

LEAD, RED.—Imported material quoted £43 5s. per ton ex store.

LEAD, WHITE.—On offer from the Continent at about £42 10s. per ton ex wharf. Spot material available at about £43 10s. per ton ex store.

LEAD ACETATE.—White refined crystals offered from the Continent at about £41 10s. per ton, c.i.f. U.K. ports. Spot material quoted £44 10s. per ton ex store.

MAGNESITE, GROUND CALCINED.—In moderate demand and price unchanged at about £8 15s. per ton, ex station.

POTASH CAUSTIC 88/92%.—Syndicate prices vary from £25 10s. to £28 15s. per ton, c.i.f. U.K. ports, according to quantity and destination. Spot material available at about £29 per ton, ex store.

POTASSIUM BICHROMATE.—Unchanged at 4½d. per lb., delivered.

POTASSIUM CARBONATE.—96/98% quoted £25 10s. per ton, c.i.f. U.K. ports. Prompt shipment from the Continent. Spot material available about £27 per ton, ex store.

POTASSIUM CHLORATE 98/100%.—Limited quantities available for prompt shipment from the Continent at about £30 per ton, c.i.f. U.K. ports.

POTASSIUM NITRATE, SALTPETRE.—Quoted £24 5s. per ton, c.i.f. U.K. ports. Prompt shipment. Spot material available at about £26 15s. per ton, ex store.

POTASSIUM PERMANGANATE, B.P. CRYSTALS.—Spot material quoted 8d. per lb., ex store. Offered for early delivery at 7½d. per lb., ex wharf.

POTASSIUM PRUSSIATE, YELLOW.—In good demand and price unchanged at about 7¾d. per lb., ex store. Offered for prompt shipment from the Continent at about 7½d. per lb., ex wharf.

SODA CAUSTIC.—76/77%, £17 10s. per ton; 70/72%, £16 2s. 6d. per ton. Broken, 60%, £16 12s. 6d. per ton. Powdered, 98/99%, £20 17s. 6d. per ton. All carriage paid U.K. stations, spot delivery. Contracts 20s. per ton less.

SODIUM ACETATE.—On offer at about £18 5s. per ton, ex store, spot delivery. Quoted £17 15s. per ton, c.i.f. U.K. ports, prompt shipment.

SODIUM BICARBONATE.—Refined recrystallised quality, £10 10s. per ton, ex quay or station. M.W. quality, 30s. per ton less.

SODIUM BICHROMATE.—English price unchanged at 3½d. per lb., delivered.

SODIUM CARBONATE, SODA CRYSTALS.—£5 to £5 5s. per ton, ex quay or station. Powdered or pea quality, £1 7s. 6d. per ton more. Alkali 58%, £8 12s. 3d. per ton, ex quay or station.

SODIUM HYPOSULPHITE.—Large crystals of English manufacture quoted £9 per ton, ex station. Minimum 4-ton lots. Pea crystals, £14 per ton, ex station. Continental commercial quality offered at £9 per ton, ex store.

SODIUM NITRATE.—Quoted £13 per ton, ex store. 95/98% refined quality 7s. 6d. per ton extra.

SODIUM NITRITE 100%.—Quoted £24 per ton, ex store. Offered from the Continent at about £22 5s. per ton, c.i.f. U.K. ports.

SODIUM PRUSSIATE, YELLOW.—Still in good demand. Quoted 4⅜d. per lb., ex store. On offer from the Continent at a fraction less.

SODIUM SULPHATE, SALTCAKE.—Price for home consumption, £3 10s. per ton, f.o.r. works. Good inquiry for export and higher prices obtainable.

SODIUM SULPHIDE.—60/65% solid, £13 5s. per ton; broken, £14 5s. per ton; flake, £15 5s. per ton; crystals, 31/34%, £8 12s. 6d. per ton. All delivered buyers' works U.K., minimum 5-ton lots with slight reduction for contracts; 60/62% solid quality offered from the Continent at about £10 10s. per ton, c.i.f. U.K. ports; broken, £1 per ton more; crystals, 30/32%, £7 10s. per ton, c.i.f. U.K. ports.

SULPHUR.—Flowers, £10 10s.; roll, £9 10s.; rock, £9 7s. 6d.; ground, £9 5s. per ton, ex store, spot delivery. Prices nominal.

ZINC CHLORIDE.—British material, 96/98%, quoted about £24 per ton, f.o.b. U.K. ports; 98/100% solid on offer from the Continent at about £22 10s. per ton, c.i.f. U.K. ports. Powdered about 20s. per ton extra.

ZINC SULPHATE.—Continental manufacture on offer at about £11 per ton, ex wharf.

NOTE.—The above prices are for bulk business and are not to be taken as applicable to small parcels.

Coal Tar Intermediates and Wood Distillation Products

N.W. ACID.—4s. 10d. per lb. per 100%. Some home inquiries.

PARANITRANILINE.—1s. 10d. per lb. Small home inquiries.

DIMETHYLANILINE.—1s. 11d. to 2s. Some home inquiries.

H. ACID.—3s. 6d. per lb. Fair home inquiries.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette, &c.

Companies Winding Up Voluntarily

OIL RECOVERY SYNDICATE, LTD. (C.W.U.V., 26/12/25.) A. Loscombe Wallis, 31, Copthall Avenue, E.C.2, Chartered Accountant, appointed liquidator, December 10. Meeting of creditors at liquidator's office, on Monday, December 28, 1925, at 12 noon.

Notice of Intended Dividend

MANGOLD, Louis Augustus, and MANGOLD, Charles Bernard, trading as MANGOLD BROS., 17, Harp Lane, London, E.C., chemical merchants. Last day for receiving proofs, January 2. Trustee, E. H. Hawkins, 4, Charterhouse Square, London, E.C.

New Companies Registered

ARCOLEINE LUBRICANTS, LTD. Registered December 18. Oil manufacturers and extractors, purifiers, refiners and blenders. Nominal capital, £1,500 in £1 shares. A director: A. H. Fawley, Arcoleine Oil Works, Manchester Road, Hyde.

NEW METALLURGY, LTD. Registered December 17. To acquire and work patents, inventions, etc., in connection with the extraction of metals or other constituents, and the blending or amalgamation of ores or minerals of any kind, including zinc, lead and spelter; to prepare for market ore, metal, etc., and to carry on other metallurgical processes. Nominal capital, £10,000 in 1s. shares. Solicitors: Birkbeck Yeo and Co., 20, Copthall Avenue, London, E.C.2.

JAMES RICHARDSON AND CO., LTD. Registered December 17. Chemists, druggists, drysalters, dyers, oil and colourmen; manufacturers of and dealers in tannin materials, etc. Nominal capital, £15,000 in £1 shares (9,000 preference and 6,000 ordinary). Solicitors: Markland, Wood and Robinson, 34, Albion Street, Leeds.

Latest Oil Prices

LONDON.—LINSEED OIL firm and 7s. 6d. to 10s. higher. Spot, £35 10s.; December, £33 15s.; January-April and May-August, £33 17s. 6d. RAPE OIL quiet. Crude, crushed, spot, £48 10s.; technical refined, £51 10s. COTTON OIL steady. Refined common edible, £43; Egyptian crude, £36 10s.; deodorised, £45. TURPENTINE very firm and 1s. 9d. per cwt. higher. American, spot, 67s. 6d.; January-April, 68s. 6d., sellers, after 67s. 6d. to 68s. 3d. had been paid.

HULL.—LINSEED OIL, spot, £34 12s. 6d.; December, £34 10s.; January-April, £34 2s. 6d.; May-August, £33 17s. 6d. COTTON OIL.—Bombay crude, £34 10s.; Egyptian crude, £35 10s.; edible refined, £39; technical, £38. PALM KERNEL OIL.—Crushed, naked, 5½ per cent., £43. GROUNDNUT OIL.—Crushed extracted, £43 10s.; deodorised, £47 10s. SOYA OIL.—Extracted, crushed, £41. RAPE OIL.—Extracted and crushed, £47 10s. per ton, net, cash terms, ex mill. CASTOR OIL and COD OIL unaltered.

Market for Motor Spirit Products in Sierra Leone

OFFICIAL figures for 1924 show that the bulk of the exports of palm oil from Sierra Leone were taken by the United Kingdom, and with a figure of 2,967 tons, this represented 95 per cent. of the total exports. Holland and Germany took sixty-five tons and twenty-five tons respectively. A noteworthy point is that during the year the United Kingdom took 97·1 per cent. of the palm kernel total export production and Germany received 1·4 per cent. This is a complete reversal of the pre-war proportions. Of the imports into Sierra Leone about 59 per cent. came from the United Kingdom and 36 per cent. from Germany. Salt and sugar figures showed marked increases. The kerosene figures were the highest since 1913, standing at 518,098 galls. Motor spirits have doubled in quantity since 1920, and the increase since 1923 amounts to 16,515 galls. There would appear to be a rapidly expanding market for such products, and soap and drug figures also show increases.

Company News

DOMINION GLASS CO.—A quarterly dividend of 1¾ per cent. is announced.

BENN BROS., LTD.—The directors have declared an interim dividend of 6¼ per cent., less tax, payable on January 1.

INTERNATIONAL NICKEL CO.—A quarterly distribution of $50 on the common stock is announced, payable on December 31.

TARSLAG (1923), LTD.—A dividend at the rate of 8 per cent. per annum on the cumulative preference shares has been declared for the six months ending December 31, payable on that date.

ELECTROLYTIC ZINC CO. OF AUSTRALIA.—The gross profit for the year ended June 30 last amounts to £510,073, and the net profit is £375,380. After carrying £12,100 to credit of debenture sinking fund reserve, writing £20,000 off investigational research and general development account, carrying £40,000 to credit of equalisation reserve, £20,000 towards new plant for west coast mines, and paying dividends Nos. 6 and 7, there is a balance of £165,932 to be carried forward.

BRITISH BURMAH PETROLEUM CO.—The net profit for the year ended July 31 last amounted to £141,217, against £52,099 for 1923–24. Refunds of taxes amounting to £6,347, and the sum brought forward (£5,585) are added, giving a total of £153,149. Of this, £67,000 has been placed to sinking fund account, £15,000 to reserve and contingent reserve, and £18,000 to exploration and development reserve, leaving a balance of £53,149. A dividend of 4½d. per 8s. share, free of tax, is proposed, payable on January 14. No dividend was paid for the previous year.

Nitrogen Products Market

Export.—During the last week only small transactions have been recorded for export. This is due to low offerings of small quantities from Continental countries. As a consequence buyers have been holding off. It appears that these quantities have now been fully bought and that as the demand for consumption will be coming along substantial sales will be made.

British producers have remained firm at £12 5s. per ton, f.o.b. for prompt shipment, with higher prices for later shipment up to end April. It is anticipated that at these prices the quantities available for export will be liquidated.

Home.—The usual small sales for December have been made, and as the price moves up in January it is expected that further sales will be made after Christmas. The heavy demand from consumers will not set in until February. Considerable sales have been made for delivery up to end May.

Nitrate of Soda.—The nitrate market continues quiet; cargoes c.i.f. chief European ports are changing hands at £11 5s. per ton for prompt arrival; higher prices are being quoted for later arrival.

Chemical Trade Inquiry

The following inquiry, abstracted from the "Board of Trade Journal," has been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

PHARMACEUTICAL PRODUCTS.—An agent in Berlin desires to represent British makers of above lines. (Reference 726.)

Tariff Changes

PALESTINE.—The importation of solar oil, diesel oil and mazut is now duty free.

GERMANY.—Reductions in rates for U.K. goods give the following figures (all in Reichmarks per 100 kilogs):—Rape seed and colza oil, cotton seed oil, in casks, 2.50; fatty oils not specially mentioned, in casks, 2.50; white lead and zinc white, 7.50.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Physical Chemistry of Steel-Making

Some Points from a Recent Symposium

ONE of the most striking features of the last few years has been the attempt, on the part of metallurgists, to correlate the experimental discoveries of the physical chemists with the hitherto empirical knowledge of the practical steel-maker, and to determine the scientific factors controlling processes of which the success, or otherwise, has been largely dependent upon the skill and practical experience of the workman. In this connection a recent symposium arranged by the Faraday Society and the Iron and Steel Institute to discuss the physical chemistry of steel making processes produced results of real value, some of which are noted below. In addition to the papers, Sir Robert Hadfield (who presided and delivered an introductory address) arranged a series of very valuable exhibits of metallurgical interest. These illustrated the progress of steel making from pre-historic times to the latest developments of electrical melting and the recent applications of X-rays and the microscope to metals and refractories. When published, the papers and the ensuing discussion should prove a valuable addition to the literature on furnace reactions, and be of great service both for those engaged in the industry and as a basis for further research.

Reactions in Steel-making

Dr. A. M'Cance in the first paper on "Balance Reaction in Steel Manufacture," made a striking use of the data already published on the dissociation of carbon oxides and water vapour as a basis for the calculation of the equilibria in the iron oxide reactions. It was pointed out that "the existing data concerning the reactions between iron oxides and carbon oxides and hydrogen were so incomplete that serious error immediately arose in the deductions therefrom, and it was obvious that until concordance was attained among the fundamental data, any extensions would give results quite uselessly divergent." The author showed that, failing direct experimental determination, progress could be made towards obtaining correct values for the equilbrium constants by arranging the possible reactions in groups, each depending upon the dissociation of water vapour or carbon dioxide. For each group of reactions, the equilibrium constants must bear certain arithmetical relations to one another, and, if some were known, the others could be calculated.

The first groups of reactions considered were those representing the action of CO. and H. on iron oxides. The equilibrium value of each of these reactions, at a given temperature, must depend upon the dissociation pressure of water or CO_2 at that temperature. The first data required, therefore, were the equilibrium values for these gases at various temperatures, and the author showed that the experimental data of various authors could be represented by the expressions :—

$$\text{For} \quad \text{CO, } \log K. = -\frac{29,500}{T} + 1{\cdot}75T + 3{\cdot}89,$$

$$\text{and for} \quad \text{HO, } \log K. = -\frac{25,500}{T} + 1{\cdot}75T + 0{\cdot}11.$$

Where the number of participating molecules in the reaction is constant, these expressions could be reduced to the form

$$\log K. = -\frac{Q}{4{\cdot}57T} + C.$$

where Q is the heat of reaction.

Starting from these values, the equilibrium values for the iron oxide/CO and H. reactions were calculated, and a series of curves showed the degree of agreement between these calculations and previously published data.

Using the same data as basis, the dissociation pressure of the two oxides, FeO and Fe_3O_4, at various temperatures was calculated, the close agreement of the values obtained by using CO_2 or H_2O was indicated by the following table :—

DISSOCIATION PRESSURES (LOG K),

Basis.	FeO			Fe_3O_4		
	1,000°	1,500°	2,000°	1,000°	1,500°	2,000°C
Dissociation of CO_2	−14·52	−8·05	−4·38	−13·99	−7·32	−3·51
Dissociation of H_2O	−14·45	−7·99	−4·33	−13·96	−7.28	−3·48

Similar equations for the equilibrium constants of the reactions of iron oxides with carbon were deduced from the data of Wheeler and Rhead for the C/CO_2 reaction.

These equilibrium constants were also calculated from consideration of the Nernst Theorem, and the agreement of the values obtained by the three lines of attack was illustrated by the example of the dissociation pressure (p) of FeO at 1,500° C.—the three methods giving values of −8·05, −7·99, and −8·03 for log p respectively. Similarly, the dissociation pressures of the oxides MnO, SiO_2, and Al_2O_3 were calculated. Using these values, the author discussed the problems of deoxidation of liquid steel; the bearing that this deoxidation has upon the nature and extent of the inclusions found in the ingot; and the methods of working to reduce these to a minimum.

A series of tables and curves demonstrated the amount of deoxidation possible using various amounts of manganese and silicon, and the author pointed out the relative values of these agents, the calculated values showing striking agreement with those obtained experimentally by Brinell.

Reactions of the Basic Furnace

The second paper, by Mr. T. P. Colclough, M.Sc., dealt with the "Reactions of the Basic Furnace," and was illustrated throughout by data derived from actual working examples taken from the furnace records of the Park Gate Iron and Steel Company. After pointing out the necessary conditions to be observed before data of value could be obtained, attention was drawn to the sources of oxygen and the importance of the oxidising effect of the furnace gases. Records of heats were given to show that the relative rates of oxidation of carbon and phosphorus depend primarily upon the basicity of the slag, and not upon variations of the temperature. These heats also furnished further evidence as to the constitution of a basic slag, and the author indicated the stages at which mass and thermo-chemical considerations exerted their full effect. The factors controlling the distribution of phosphorus were commented upon, and the impracticability of the calculation of an equilibrium constant for the iron oxide-phosphorus reaction shown.

The reaction of manganese and ferrous oxide was then studied and a value of $10{\cdot}1 \times 10^{-4}$ suggested for the equilibrium constant. Examples of the reversibility of the reaction were given, and the factors governing the distribution of manganese between slag and metal indicated. Attention was directed to the importance of this reaction upon the quality of the finished steel.

Data were given to show the close parallelism between the distribution of manganese and the process of desulphurisation; the conditions for the elimination of sulphur were indicated, and the importance of slag composition demonstrated.

Examples were also given to show the variation in compo-

sition of the iron oxide with the different types of slag, and further evidence in support of the probability of the formation of lime-ferric oxide compound under certain conditions.

Basic Electric Furnace

A paper by Mr. F. Sisco, of the U.S. Air Service, on the "Basic Electric Furnace," gave a very full description of the working of electric furnaces in America. It was indicated that, by varying the charge and the temperature during melting, it was possible to obtain a bath of metal with complete, partial or minimum oxidation. The relative advantages of these methods of working, and the different methods of finishing the heat were described. The reactions during melting, and the importance of the slag composition and temperature upon the elimination of carbon manganese and phosphorus, were fully dealt with.

A very detailed account was given of the different types of slag used during the deoxidation period; of the reactions which occurred; and the conditions necessary for successful deoxidation and degasification of the metal. Special attention was drawn to the importance of slag control; the factors controlling the elimination of sulphur and its relation to the problem of deoxidation were discussed; and equations to explain the action of fluor spar were suggested.

Mr. A. L. Field (New York), in a contribution on "Physico-Chemical Phenomena from Melt to Ingot," expressed the need that was felt for a workable theory to explain the effects and action of zirconium on steel.

Slag Problems and Refractories

In this section Mr. J. B. Ferguson (Toronto) contributed a paper on "Equilibria in Systems involving Ferrous Oxide," in which reference was made to the discrepancies revealed in the work, published by various investigators, on the systems Fe—O—C and Fe—O—H. Reasons for the discrepancies were suggested and the points of agreement indicated.

In a paper on "Slag Reactions," Dr. P. MacNair discussed the conditions necessary for equilibrium between the furnace lining and the slag, and the changes which tend to occur in the slag as reaction proceeds. It was claimed that the slag consisted of oxides of various elements in contact with the oxides of the lining; with a fluid slag, the tendency was either to absorb oxides from the lining, or for the reactions of the process to proceed towards the production of a more viscous slag. The changes in the acid process were the most obvious confirmation of this tendency of slags to become more viscous, and the action of CaO and temperature were reviewed in the light of this theory. The author suggested a limiting value for the CaO/SiO_2 ratio in a basic slag, and discussed the bearing of the viscosity of the slag on the stability, or otherwise, of MnO, P_2O_5, and FeO.

Mr. J. H. Whiteley, F.I.C., discussed "The Function of Ferric Oxide in Acid and Basic Slags." In the acid process the ferric oxide acted as a carrier of oxygen from the furnace gases to the metal, being alternately reduced to FeO by the metal and reoxidised by the gases. As much as 50 per cent. of the oxygen requirements of the bath could be supplied by this process. In the basic furnace, this occurred to an even greater extent; the proportion of oxide present as Fe_2O_3 was always higher than in the acid process, and, with highly basic slags, the formation of lime-ferric oxide compounds was probable.

The final paper, by Mr. W. J. Rees (Sheffield University), dealt with the "Micro-examination of Steel-making Refractories." This excellent contribution, amply illustrated by lantern slides, showed clearly the bearing of the grain size and quality of the raw materials on the changes during "firing," and the crystalline character and utility of the final product.

Rapid Lixiviation of Metallic Salts from Ores

From a Correspondent

NUMEROUS inconveniences attend nearly all methods of extraction with cold liquors. The recovered solutions, being very dilute as a rule, are large in bulk, and therefore require considerable concentration. Among other things, this entails excessive consumption of fuel, more labour, and the use of a large plant. This not only means that the work is troublesome and tedious, but sometimes uneconomical, as considerable loss by infiltration occurs due to the leaks formed in the masonry.

By conducting the process of extraction in closed vats, under pressure, and at a temperature 100° C., much more rapid and effective lixiviation can be maintained. This method may be applied to several ore treating processes, including the wet extraction of copper from low-grade material. Difficulty is often experienced in bringing the metallic constituents into solution when the material is of an insoluble nature, and where the washing plant is large, the consequence being that the whole process may be held up because of the inefficiency of one department. The acid solutions used in the wet copper and nickel processes are often only heated by the steam of the "jack" which raised them. In other processes the heat is supplied from the waste steam of boilers, being led directly into the vat by means of flexible tubing. As the condensed water from the steam is added to the contents of the vat, the bulk of the liquor is increased instead of decreased. These older methods have now been largely superseded, more modern principles being employed which need not be entered into here except to point out the advantages gained by the application of hot extraction.

Regarding the plant used, this is somewhat similar to that of the diffusion batteries used in sugar works. This means, of course, that comparatively small charges only can be worked at a time, and therefore the rapidity of the lixiviation largely rests on the efficiency of the plant. The apparatus is somewhat flat in shape, lined with thin sheet lead, and provided with a filtering surface.

This filtering surface is made up of several different preparations, depending on the variety of material which has to be treated, and may vary from glass wool or asbestos cloth to sawdust mixtures.

Manipulation

After charging the roasted mass, or material under treatment, the water or acidified liquor is run in. In order to avoid loss of heat in the spent mineral only the last members of the series are heated, and those, too, after the liquor is already in a state of cold saturation. By this means the heat stored up in the spent mineral is recovered by the subsequent cold liquor, and each unit is not discharged until thoroughly cooled down. At the point where cold saturation has been effected, residual liquors may be introduced, thus reducing the amount of fresh water required. A fixed depth or thickness of roasted ore is adhered to, in order to prevent undue resistance (caused by caking, etc.) to the passage of the liquor. In some of the more modern types of extraction batteries, facilities are provided whereby the vessel is kept in constant motion. Under these more favourable conditions the thickness can be increased, and would correspond to an increase in the volume of liquor obtained. After the treatment has continued for a certain period, the hot concentrated liquors are gathered in a reservoir fitted with baffles, where the insoluble matter is allowed to separate out. From the reservoir the hot liquors pass on to the reduction process and afterwards to the crystallisers.

As some difficulty may arise in the separation of solids from the hot liquor which is capable of crystallising out, it is necessary to employ a specially constructed filter. This is somewhat similar to the filters employed in the treatment of syrups in sugar factories, except that arrangements are made to keep the apparatus heated, and thus prevent any crystallisation taking place.

Notes on Results Secured

Working in the foregoing manner, it will be observed that best results should be secured where the mineral to be treated consists of an insoluble porous skeleton containing a mixture of soluble salts, the latter amounting to only a small proportion. The principal advantage gained is that, by causing hot liquors to circulate through the roasted mass a sufficient number of times, a hot saturated solution is prepared which does not require further concentration. Ordinary lixiviation

processes, on the contrary, produce large quantities of weak liquors which then require to be concentrated, thus entailing considerable expense. By the hot extraction method, the consumption of heat is represented simply by the number of calories required to raise the temperature of the concentrated liquor from 15° to 100° C., which works out at a saving of 250,000 calories per cubic metre of 48° Twaddle liquor, that is, approximately 83 per cent. of the total quantity. The application of this method of working to roasted copper ores offers advantages which are more than appreciable, for in the precipitation department considerable saving in the amount of scrap iron used is effected, as the solutions do not require to be strongly acid. Weak acid liquors are more easily handled, and have little or no action on sheet lead or pipes. On the other hand, liquors rich in copper tend to exert a slight electrolytic action which sometimes increases corrosive influences. In this manner the respective corrosive actions of rich copper liquors and strongly acid weak copper liquors almost balance each other. Regarding the cost of the plant used in the process referred to, the initial outlay is somewhat higher than where cold lixiviation is conducted. On the other hand, little repair work is required as a rule, whereas the wooden tanks employed in the cold process constantly require attention.

The Estimation of Phosphorus

0SX01

By H. Burton-Smith

THERE are several methods used for the estimation of phosphorus in iron and steel, but they all ultimately end with the phosphorus being precipitated by the addition of an ammonium molybdate solution. It is with interest that the metallurgist looks upon this estimation when he visits another laboratory, for the various works have different methods of leading up to the final precipitation.

It is the intention of the writer to relate a method, which has been found to give excellent results and works admirably with all classes of iron and steel, whatever the other ingredients are, but the usual precautions have to be taken when high speed steels are under examination.

It is not a new method, but a combination of the many that are now in use, and is quite rapid, for a gravametric phosphorus result can be given in 1¾ hours, and even less if necessary.

Three grammes of drillings are taken in solution by dissolving in 35 cc. 1·2 nitric acid. When the violent action has ceased, the solution is evaporated down to dryness, care being taken in order to prevent any spitting. The cake is well baked, this being apparent when all the fumes have been driven off and the cake has no smell. The beaker cooled, 20 cc. conc. HCl and 2 cc. conc. HNO_3 are added, and the solution allowed to boil down to dryness. At this point it is not necessary to bake again, but just to let the pasty mass become dry. Another 20 cc. HCl and 2 cc. conc. HNO_3 are added, and again boiled down, until a concentrated solution of about 5 cc. is obtained. It is not wise to go below this point, or part of the iron will separate out of solution, and a further addition of HCl will have to be made. On the other hand the solution must be as concentrated as possible in order to have no more free acid present than is absolutely necessary. Any particles adhering to the sides of the beaker are loosened by means of a "policeman," the solution diluted with hot water and made up to 30 cc. 20 cc. of this are filtered off, the 20 cc. representing 2 grammes of steel. This fractional filtration lessens the time considerably. The filtrate is now transferred to a small beaker and 15 cc. of an ammonium molybdate solution are added and the solution well shaken. The precipitate comes down almost immediately, the shaking continued for a minute or so, then allowed to stand till all the precipitate of ammonio-phospho-molybdate has fallen down, leaving a clear solution. The solution is now filtered through a 9 cm. Swedish filter paper, the beaker washed two or three times with dilute nitric, the washings passing through the filter paper, and then in the same manner with a dilute ammonium nitrate solution. The funnel containing the filter paper is now placed over a weighed silica dish. The beaker is washed with dilute ammonia, 1 in 3, and the washings poured over the paper; repeat the washings, using as little as possible each time. The paper is washed with the dilute ammonia once or twice more. The solution in the silica dish now contains all the ammonio-phospho-molybdate which the ammonia has taken into solution. The filter paper is removed and squeezed through the fingers so as to allow the last drop of washings to fall into the dish. The dish is placed on the hot plate and allowed slowly to evaporate. When quite dry it is placed on the hottest part of the plate to eliminate the last traces of ammonium nitrate, allowed to cool and re-weighed. The difference in the weight gives the weight of two grammes of ammonio-phospho-molybdate and from this the percentage of phosphorus is calculated.

Weight of dish + $(NH_4)_3PO_4,12MoO_3$	12·398
,, ,, ,, ...	12·342
,, ,, $(NH_4)_3PO_4,12MoO_3$	·056
·056 × 1·65 ÷ 2 = ...	·046% P.

Solutions.

Ammonium molybdate.

150 grm. dissolved in 750 cc. distilled water, filter, make up to 1,500 cc.

375 grm. ammonium nitrate in

390 cc. distilled water, filter of 600 cc., add 300 cc. conc. HNO_3, then cool.

To the ammonium nitrate solution slowly add the molybdate solution, shaking the whole time.

Ammonium nitrate wash solution.

20 grm. $(NH_4)NO_3$ dissolved in distilled water, filtered, add 20 cc. conc. HNO_3, make up to 1 litre.

When the molybdate solution is added the filtrate is practically cold. In precipitating the phosphorus in this manner, one is certain that if any arsenic is present in the metal under examination, there is no chance of it coming down with the phosphorus. Unlike in many of the other methods the precipitate tends to cling to the sides of the beaker, hence special care has to be taken in washing out the beaker during the latter operation. During the earlier part of the estimation there is little danger of not converting the whole of the phosphorus to the othophosphoric acid state. Attention is drawn to the making up of the molybdate solution, for, if the conditions under which the solution is made are not strictly adhered to, there is no chance of getting a good precipitate. It is well known that when a phosphorus estimation is being carried out, if the phosphorus does not come down straight away and on standing leave a perfectly clear solution, the best thing to do is to throw it away and start afresh, for it is very unwise to tamper with the precipitate in any way.

Distance Thermometers

IN nearly every metallurgical process the application of heat plays an important part, and the accurate and continual control of the temperatures involved is essential. A pamphlet has been issued recently by Negretti and Zambra, 38, Holborn Viaduct, E.C., entitled "Distance Thermometers," in which the advantages of their dial thermometers and distance recorders are concisely described.

A dial with a pointer is more accurately and easily read than a liquid column in a glass tube, and is less liable to accidental breakages, as the bulbs are of metal and in consequence more robust. A usual feature of the modern workshop is centralised control and the dial thermometer has every advantage for this purpose. Dials may be fitted at distances up to 150 ft. away from their bulbs and can hence be fitted to one instrument board, obviating the necessity of visiting each thermometer separately. Moreover, a transmitting dial movement may be applied to a recorder to give automatic written records of temperature changes, and this application is of advantage in processes which extend over a considerable period of time.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

The Colour-tint Test for Refractories

THERE are fashions in metallurgy just as in other things, and at the moment the discussion and investigation of refractory materials and their behaviour in high temperature conditions are very much to the fore. The reason is not an arbitrary one, such as determines the style, cut and colour of garments, and so reacts on the textile and dye industries, but is governed by considerations of fuel economy and the vital need of getting every potential calorie to do its duty. Hence the current literature of refractories in their application to metallurgical requirements is becoming voluminous. There is also a growing need for rapid methods of testing, in order to ascertain whether the materials possess those properties of resistance, conductivity, etc., on which their efficiency so greatly depends.

Sulphur prints and heat tinting are well known devices in metallurgy, but colour etching is new as a means of testing refractories. Steinhoff and Hartman have devised an interesting test of this description, an account of which has appeared in a recent number of *Stahl und Eisen*. The specimen, after cleaning, is boiled in a solution of equal parts of strong hydrochloric acid and saturated aluminium chloride. After cooling it is thoroughly washed in water and then treated, for half an hour, with a concentrated solution of methylene blue. After washing, the tint-effect, which eventually fades away, is observed. A more permanent effect can be produced by modifying the process. The differential tinting produced varies, it is said, with the firing temperature of the bricks, their different constituents, and the impurities present. The quartz transformation phases are also revealed by this method, yielding useful information.

The Perils of Sampling

THE analysis and sampling of materials is by no means the simple and rule-of-thumb task that some people, even those who should know better, believe it to be. Personal equations stand for much in even minor analytical operations. The Ridsdale method of employing tabloid reagents helps to eliminate certain sources of error, and their use has, from this point of view, much to commend them. The use of carefully standardised samples having well established and certified percentages of special constituents, such, for example, as the British Steel Standards (prepared under the joint supervision of the Iron and Steel Institute and the National Physical Laboratory), affords a further instance of means whereby the tiresome and intrusive personal equation may be "equilibrated." The difficulties which attend the merely chemical operations may, however, be guarded against. In the case of sampling, which has sometimes to be entrusted to comparatively unskilled hands, many other dangers arise. There is the old device of "drawing the cone" by which a skilled sampler may trap a neophyte in the art. There is also the question of screening. The composition of the fines may vary greatly, particularly with powdered substances such as pig iron, from the composition of the larger particles. This necessitates the careful pulverisation of the sample at all stages of fractional subdivision. Here, too, the question of sifting largely governs the result, and sifting depends upon the use of screens which must, moreover, be of the right kind.

The Standardisation of Screen Meshes

THE greatest confusion exists, as regards mesh dimensions, through the different units of measurement applied to sieves in different countries. C. Ratel, in one of our French contemporaries, has done useful work in calling attention to this matter. The mesh of French sieves is referred to the number of linear divisions in a French *inch*, which is 27 millimetres. Such divisions are called "maille." Concurrently with this system, an *English* inch (25·4 mm.) is also employed, the linear subdivisions of which are called the "mesh." The ratio of the maille to the mesh thus becomes 1 : 1·063, and confusion begins from the very commencement. Further, the number of holes (mailles or meshes) in a linear unit determines the description of a given screen, without taking at all into consideration the diameters of the wires of which it is made. Hence, merely stating the number of holes per linear unit conveys absolutely no definite information as to the actual size of the holes, or of the order of size of the resulting particles sieved through them. This has been long recognised, and systems of a more accurate and scientific description have been put forward. They include the series of the Institution of Mining and Metallurgy, the Hoover Series, the Rittinger, the Richards, and the Tyler. A new Standard series is put forward for French sieves, and the question of what gauge wires should be adopted is considered, comparative tables of the various international wire gauges being given. The application of various sieves to given materials and the comparative efficiency of crushing machines are likewise discussed.

Coking Highly Bituminous Coal

NECESSITY is the mother of invention, and coals which will not coke, or coke badly, can be made to give good coke by methods which have recently been introduced in the Sarre district, but which might, with advantage, be copied elsewhere. The Sarre coke is highly bituminous, having 31 to 34 per cent. of volatile matter. On coking it by itself great shrinkage takes place. From experiments undertaken at the Heinitz plant of the Burbach Works of the Arbed Co., to remedy this defect, it has been found that, in drawing it from the ovens, it presents every appearance of being a perfectly satisfactory metallurgical coke. It is, however, so friable that on transport it breaks into small lumps, accompanied by an economically undesirable proportion of fines. This is due to the large amount of volatile matter in the original coal, and therefore the practice has been adopted of mixing the coal with leaner coals from other regions, in the proportion of 10 to 25 per cent. of leaner coal, the mixture being intimately mingled and powdered before charging to the ovens. Coking the unpowdered mixture in specially narrow ovens is alternatively practised, both methods yielding excellent hard coke. It is obvious, however, that the dependence upon outside coal supplies would lead to a precarious situation. The problem has been solved by rendering part of the home supply leaner, by partial distillation, previous to mixing it with the remainder of the untreated native coal. The semi-distillation is conducted in small rotary ovens at a temperature not exceeding 450° to 470° C. Tests have shown that the coke, which is obtained by mixing the native coal with the semi-distilled product, is so far superior to that obtained by coking the native coal in the ordinary way, that a plant has been installed capable of supplying the needs of a battery of thirty ovens. The added coal is dried washery fines, and the coking period four hours. Only 20 per cent. of the mixture being volatile, an excellent yield is obtained. The low temperature carbonisation of the admixture gives a high yield of valuable gas and by-products.

The Economics of Mill Design

THE inseparable connection between applied science and economics, a connection emphasised many and many a time in these columns, receives further exemplification from the illuminating discussion which took place last month in the theatre of the Institution of Civil Engineers, on Mr. T. W. Hands' paper on "Progress in British Rolling Mill Practice." This was read before the Iron and Steel Institute, the members of which may well be trusted not to lose sight of the connection referred to above. In this discussion many very true and striking statements were made. Speaking of the three-high continuous mills of the 7 in. to 12 in. class, Mr. F. Anslow said many such mills had been put down in Great Britain for producing large outputs cheaply, so long as trade was good.

The difficulty was to lay down mills which would operate economically under all conditions of reasonable output. Mr. L. D. Whitehead remarked that when production in some mills fell to 70 or 80 per cent. of the maximum output, capital charges began to pile abnormally, whereas in other types the output might fall to 40 per cent., and not materially affect standing charges. Sir William Ellis warned those present to effect such economies as were deemed necessary, and justified expenditure for such purposes—not large expenditure, but necessary expenditure—on the ground that, when an industry

was suffering from uneconomic production, true economy was best served by such means. The salient point emerging from the discussion was that economy, like everything else, is relative; that what is economical, where large outputs are not only made, but can be disposed of, is not necessarily economical when markets are restricted, demand halting, and large outputs cannot be absorbed.

Problems of Output

THE new problem with which the country is faced, whether merely a passing phase, or whether, as some people seem to fear, a permanent one, is how best to make small outputs pay. It is one which applies for the moment with peculiar force to the iron and steel trades, in which, in normal times, the largest outputs are invariably the most economically advantageous. In any case, and while present conditions last, the mill designer is faced with an entirely new problem. He has not to lay down a mill which, at full capacity, is capable of highly economic outputs; he has to lay down a mill which shall be an economically producing industrial unit, on a *minimum capacity*. It must therefore satisfy two very different requirements. The mill engineer has to decide as to how he is to make mills intended, at times of maximum demand, to deal with relatively very large tonnages, at the same time economically capable of producing very small tonnages. Are existing mills to be scrapped—a counsel of despair—or modified, more or less expensively? Sir William Ellis advises the latter course, and his advice would seem to coincide with the strongest dictates of prudence and common sense. The problems of mill design, modification and improvement run parallel with the other problems which beset the heavy trades of this country. The future may, or may not, bring promise of prosperity and relief; the present is with us, to be dealt with *now*. It will need all that is best in brains, in energy and in determination to grapple successfully with these problems, which are problems of engineering and metallurgy, no less than of finance and economics. The trade, too, must stand together, for the problems are common problems, and involve considerations in which union is more than strength; it is salvation.

Cast Iron Research

THE Council of the British Cast Iron Research Association has recently extended the research programme by arranging for an investigation on the influence of silicon, manganese, and phosphorus on the formation of graphite in cast iron, to be conducted by Mr. M. L. Becker, M.Sc., at the University of Manchester, under the supervision of Professor F. C. Thompson, and for an investigation to be commenced at the National Physical Laboratory under the supervision of Dr. W. Rosenhain, F.R.S., on the alloy systems, iron-silicon, iron-manganese and iron-phosphorus, in the presence of carbon, over the range usually associated with cast iron. It is anticipated that these fundamental investigations will yield information of great value in connection with other investigations in hand. The Director and Consultant of the Association are now visiting Continental laboratories and works for the purpose of examining recent foundry developments, particularly in Germany.

A Growing Membership

AT a recent meeting of members it was decided that the maximum annual subscription should be reduced to 100 guineas. The minimum is at present five guineas per annum for the smallest foundries and varies with the size of the foundry concerned. Recent new members of the Association include Henry Wallwork and Co. (1920) Ltd., Manchester; Boulton and Paul, Ltd., Norwich; British Piston Ring Co., Ltd., Coventry; A. S. Smith and Sons, Walsall; Castings, Ltd., Walsall; John Fowler (Don Foundry) Ltd., Sheffield; Linotype and Machinery, Ltd., Altrincham; Metropolitan-Vickers Electrical Co., Ltd., Manchester; C. and B. Smith, Wolverhampton; J. Stone and Co., Ltd., London; Charles W. Taylor and Son, Ltd., South Shields; John Wood and Sons, Ltd., Wigan; The Midland Electric Manufacturing Co., Ltd., Birmingham; Edward Stevenson, Ltd., Nottingham; Centrifugal Castings, Ltd., Kilmarnock; Ransomes, Sims and Jeffries, Ltd., Ipswich; R. E. Barker, Purston; The Goldendale Iron Co., Ltd., Tunstall; British Engine, Boiler and Electrical Insurance Co., Ltd., Manchester; National Boiler and General Insurance Co., Ltd., Manchester; The Worsley Mesnes Ironworks, Ltd., Wigan; and the Staveley Coal and Iron Co., Ltd.

Treatment of Zinc Retort Residues

A DISCUSSION of the metallurgical treatment of zinc-retort residues is contained in Technical Paper 341, just issued by the U.S.A. Bureau of Mines. The residues resulting from the retort distillation of zinc ores have 25 to 75 per cent. of the weight of the original ore and contain 5 to 15 per cent. of zinc. They consist of unconsumed coal or coke and the constituents of the ore that are not volatilised during the distillation of the zinc. Retort smelters in the United States produce normally an annual average of 45,000 tons of distilled primary zinc, as distinguished from electrolytic and redistilled secondary zinc. On the assumption that about 1 ton of zinc is produced from 2 tons of concentrate, there must be normally about 900,000 tons of concentrate treated annually in retort smelting plants. If the weight of retort residues is estimated to be 40 per cent. of the weight of the concentrates smelted, and is assumed to have an average zinc content of 8 per cent., it is roughly calculated that approximately 360,000 tons of residues, containing about 28,800 tons of zinc, are produced annually in the United States. Besides the current production of residues, there are at many smelter sites large accumulations from past operations available for treatment whenever treatment becomes profitable. In addition to zinc, the residues contain much unburned coal, carbonised or converted to coke during the distillation process, while residues from most Western zinc ores also contain lead and silver.

Residue Utilisation

THE treatment of these residues for the recovery of the contained coke and metal values presents a fertile field for investigation and has received the attention of many metallurgists, as is manifest from the number of methods that have been tried and of processes that have been patented. The Bureau of Mines has received so many inquiries concerning the possibility of profitably treating retort residues, that an investigation of residue utilisation was deemed advisable. As a first step a survey was made of the processes already tried and of those now in use. The treatment of broken retorts and condensers was included in the survey as a closely related subject. This survey showed that there was little occasion for further experiments of a general nature, but that the management of each individual zinc-smelting plant must decide for itself, according to local conditions, the feasibility of, and the best methods for, treating residues profitably. In Technical Paper 341 there is a description of a variety of methods for the treatment of zinc retort residues. Most of these methods are or have been in actual use in one or more zinc smelters. Different conditions require different methods; some methods have been successful in certain plants and unsuccessful in others.

It is probable that conditions at some plants prohibit the profitable treatment of retort residues by any method; on the other hand, it is probable that many companies, which do not now treat their residues, could do so by selecting the proper method and adapting it to their particular conditions. The treatment of old condensers is simpler than that of retort residues, and it seems that most zinc smelters could with profit build at least a simple jigging plant for their concentration.

Technical Paper 341, "Metallurgical Treatment of Zinc-Retort Residues," may be obtained from the Superintendent of Documents, Washington, D.C.

Corrosion in Iron Piping

AT the annual general meeting of the Institution of Gas Engineers, held recently, the wrought iron tubing committee's report recommended that steps be taken to ensure that the gas barrel supplied to the industry be only of superior quality wrought iron, and that a metallurgist be employed to draw up a standard specification and tests for wrought iron piping satisfying the conditions. While strongly recommending the use of wrought iron piping, the committee desired to direct attention to the deleterious effects produced upon gas barrel—whether wrought iron or steel—arising from internal corrosion attributable to the presence of carbonic acid oxygen and water vapour in the gas passed through the barrel, and the committee suggested that all practical steps should be taken to reduce to the minimum the amount of oxygen contained in the gas.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

We have now reached the end of the second quarter of the year, and we can say nothing better than that the iron and steel trade is as bad as, if not worse than, ever it has been since the war; not only that, but there are no indications to lead one to expect any improvement. It becomes rather wearying to have to write in this strain month after month, but actual conditions allow no alternative. We have always endeavoured to cultivate optimism and in these days it is more than ever necessary to keep a cheerful courage, but it is no easy matter. The newspaper reports which appear from day to day are not encouraging. Occasionally we find a company making a profit and paying a dividend, but they are the exception. Guest, Keen and Nettlefold's results recently published were very gratifying, but there are special circumstances to account for that and they cannot be taken as representative of the iron and steel trade proper. On the other hand, we have the Ebbw Vale Co. and Beardmores reporting heavy losses, and the same story is told by many of the smaller firms. Where is it going to end? Losses cannot be piled up indefinitely. It is not far from the truth to say that some of the larger concerns are held up merely by their own weight, and it makes one fearful of the future.

The Coal Situation

As though there were not sufficient cause for anxiety in the trade itself, we are once again faced with the prospect of a trial of strength between the colliery owners and the miners. The owners find themselves in such a serious position that they are compelled to give notice to terminate the existing wages agreement at the end of July. They attribute the main cause of the difficulties under which they are labouring to the increased cost of production, due mainly to the shorter working hours and to the terms of the existing agreement. On the other side the men's leaders seem determined to resist the reversion to longer hours, and the men are even demanding, through their secretary, an increase in wages. It is usual in such disputes for each side to start with its maximum demands and a compromise is effected somewhere between the two extremes. We can only hope that when the two sides get together some satisfactory solution will be found which will avoid actual conflict. It is true that in many cases the men's wages are very low in actual value as compared with the past, but higher wages and less work are not a logical combination in these days, when the utmost effort is required on the part of everyone to make up for the destructive war years. We still have to learn the lesson that has been forced upon the German workers, that to maintain the higher standard of living that was fostered by the boom times of a few years ago, or even the pre-war standard, we shall all have to work harder. There has been too much indulgence in luxuries, not the least of which is the shorter working day accompanied by higher rates of wages.

There is no denying the fact that the coal trade is experiencing the same distressing conditions which the steel trade has had to bear for so long. The export demand is very much down, and the home demand is reduced owing to the shortage of orders in the works. The selling price of coal to-day leaves no profit to the colliery owner, and still it is higher than it ought to be, to give the steel trade a chance of pulling round. Frankly, it would have been better if this matter had been fought to a finish in 1921. The settlement then made was at the best a compromise containing the seeds of future trouble, and these are now beginning to bear fruit. Since then the coal trade has had one very good year—1923—and this makes it all the more difficult to bring home to the men the present serious condition of affairs. If the worst comes to the worst and we have another coal strike, it may well mean disaster for a considerable section of the industry of the country. There must be several collieries and works which are so near the border, that to be shut down by a strike for any length of time may prevent them from ever starting again.

Falling Prices

In every department of the steel trade prices are still falling. We are still in the condition that any consumer who has a good order to place can secure a reduction on whatever market price may be ruling. The steel makers have obtained some assistance from the lower prices of fuel. Coal supplies for the next quarter show a reduction on the present prices, and coke is down by 2s. to 3s. per ton. Scrap is also very weak, the price for good heavy scrap being round 60s. per ton delivered into works. A reduction on these three items means a substantial relief in the cost of steel making. Unfortunately this relief, as on previous occasions, merely follows reductions in selling prices, and the lower costs seem to be an inducement to certain makers to cut prices still further. We have seen one very low quotation which was excused by the maker on the expectation of relief under the Safeguarding of Industries Act! The application for assistance under that Act is under way, and already considerable opposition is being prepared. The one thing certain is that the steel trade needs assistance; it cannot by any ordinary means meet the competition from the continental makers, who are receiving a heavy subsidy through their depreciated exchanges. The re-rollers in this country benefit from this condition, the manufacturers lose by it. Surely it is possible for the two interests to work out some scheme which will give to each the measure of security they need?

Belgian Steel Strike

The strike in the Belgian steel works seems likely to spread and the Belgian makers are refraining from quoting. The continental merchants are still sending out their quotations as before, and they are evidently willing to take the risk. So far the strike has not benefited the English works to any appreciable extent, but if it is prolonged the delay in delivery is bound to divert some orders to the works here.

There have been general reductions in pig iron prices since last month. Some of the prices at which iron is being sold are well below the cost of manufacture in even the most up-to-date plant. As low as 65s. at the furnaces has been quoted for No. 3 iron, but most makers are holding out for more than this. Buying is still very restricted. There may be some improvement owing to the lower cost of coke, but the lack of work in the foundries and the ironworks does not give much confidence. Hematite is no better, if anything, it is worse. More furnaces have been put out, and others are working from day to day, ready at any moment to shut down. Finished iron is exceedingly dull, and it is doubtful if any of the works are employed to 50 per cent. of their capacity. This is no surprise when one remembers that the continental makers are selling bar iron in this country at pounds per ton less than our prices.

The price of basic steel billets was reduced, in the early part of the month, by 10s. per ton, and now the acid billets have followed suit. The market still remains poor. Finished steel is finding ever lower levels of price. The re-rollers are selling bars at £8 10s. or less, whilst the steel makers' price is £9 to £9 10s. Sections are being offered at £8 5s. basis, and less than this would be accepted for a good order. Plates which are nominally £9 5s. basis are being offered by the North-East Coast makers at £8 17s. 6d. delivered into the Midlands. It is only for the special qualities of steel, such as deep stampings, motor car work, and boiler plates that profitable prices can be obtained. Fortunately the motor car trade and the consequent demand for deep stamping steel are quite good.

Railway Orders

A good deal of satisfaction was caused by the news that the London, Midland and Scottish Railway had given out orders for large quantities of rails. Messrs. Steel Peech and Tozer, Cammell, Laird and Co., and the Frodingham Iron and Steel Co. have each received orders for 10,000 tons, and Messrs. S. Fox and Co., of Stocksbridge, for 6,000 tons. Other firms have also participated. The contracts are for delivery over a period, and while they do not mean an immediate rush of work, they are definite business which is very welcome to the firms concerned.

The output of pig iron in May amounted to 568 000 tons compared with 569,800 tons in April. The number of furnaces in blast was less by one that at the beginning of the month. The output of steel ingots and castings was 651,600 tons compared with 597,600 tons in April and 809,700 tons in May, 1924. It will be noticed that there is a marked decrease in comparison with last year.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Obtaining Aluminium by Electrolysis

IN a process for obtaining aluminium, by the Aluminum Co. of America, of Pittsburg, U.S.A., alumina is fused and solidified, and then finely divided, and added to a fused bath of fluorides of sodium and aluminium. The fineness of the particles of alumina is such that they remain suspended until dissolved. In this case, the presence of iron and titanium oxides and silica is not harmful. See Patent Application 232,189, having the International Convention date, April 10, 1924.

Concentrating Low-grade Iron Ores

A PROCESS for treating low-grade iron ore containing a large percentage of silicic acid has been patented by Maschinenbau-Anstalt Humboldt, of Köln-Kalk, Germany. The coarsely broken ore is subjected to a reducing roasting at a temperature too low to produce sintering, and then quenched in water. This loosens the quartz and ore particles, and the very fine ore can then be separated from the coarser particles and the quartz by washing, so that the concentrate contains a large percentage of iron. The residue of quartz and coarse iron ore particles is then treated in wet magnetic separators and mechanical separators. Examples are given of the treatment of some low grade ores, showing that the ore can be enriched to double its original iron content. See Patent No. 234,377, dated November 11, 1924.

Iron Manufacture

To produce iron having a low sulphur content, a mixture of iron ore, coke, anthracite fines, bauxite in lump form, diaspore or other material containing aluminium oxide, and limestone in small lumps, is smelted in an electric furnace. A calcium aluminate slag is produced, containing 30–50 per cent. alumina, and less than 20 per cent. of silica. Ferruginous bauxite is preferably used, in which case the iron is reduced. The slag may be crushed and leached with warm sodium carbonate solution and the alumina precipitated by carbon dioxide after removal of silica, or the aluminate slag may be used for the manufacture of Portland cement. See Patent Application by Norsk Aluminium Co. of Oslo, Norway, No. 232,930, having the International Convention date, April 23, 1924.

Alloys

ACCORDING to an invention by A. L. Pocock, C. T. Calver, and W. H. Watkins, of London, tellurium is added to a metal or alloy by introducing it below the surface of the molten metal. The tellurium may be added as an alloy with a metal which may be the same as that treated. It is found that this treatment improves the strength, uniformity, and fluidity of the metal, and the shrinkage after casting is diminished, so that sharp castings can be obtained. In the case of gold-like alloys of copper and aluminium, tarnishing is much reduced. The tellurium or tellurium alloy is enclosed in metal foil or in a capsule, and introduced below the surface of the molten metal, which is covered by any suitable flux. A number of examples are given showing the effect of this treatment on various metals and alloys, principally of copper and aluminium. In the case of aluminium alone, it is found that the metal obtained expands considerably on cooling. See Patent No. 234,547, dated February 27, 1924.

Treatment of Lead

A PROCESS for incorporating phosphorus in a bath of molten lead, designed for use in coating iron or steel with a protective covering, has been patented by American Machine and Foundry Co. of New York. An alloy of phosphorus and lead is first made by confining lead with about 1–5 per cent. of phosphorus in a sealed metal receptacle or bomb, displacing the air with nitrogen or carbon dioxide, and heating the bomb to about 650° C. for six hours. The phosphorus thus becomes incorporated in the lead, and the alloy obtained may be added as required to a lead bath. It has been found that a bath containing 0·0003 per cent. of phosphorus is satisfactory. In this process, no foreign metal is introduced into the lead bath, as when phosphor-tin is used. See Patent No. 234,648, dated June 19, 1924.

Manganese-Silver Ores

IT is believed that the metallurgical treatment of refractory manganese-silver ores of one type has been solved as the result of experimental work undertaken by the United States Government in co-operation with the Netherlands East Indies Government. The treatment of such ores is being successfully accomplished by the use of the Caron process, which formed the basis of the investigations, and the results of the experimental work are given in Bulletin 226, recently issued by the Bureau of Mines, Washington.

The Caron process is based on the discovery that when oxidised ores containing a refractory compound of silver and manganese are heated in a reducing atmosphere—so as to reduce completely the higher oxides of manganese to manganous oxide—and are cooled under conditions that will prevent reoxidation, the refractory compound is decomposed and the silver is rendered amènable to cyanidation. This process, in combination with cyanidation, has been demonstrated through tests of typical samples from widely separated localities to be the most effective treatment for the majority of manganese silver ores. The Clevenger furnace and cooler unit has been developed, whereby reduction can be obtained with high fuel economy, and reversion to the refractory state can be prevented.

The Carron Process

The investigation was undertaken because of the need for the development of a process to treat manganese-silver ores found in the two countries, and the following general statements may be made regarding the problem and the particular application of the Caron process. On account of the intimate association of the manganese and silver, all methods of concentration and direct lixiviation of the raw ore have been proved unsuitable, as also are all methods of lixiviation of ore calcined under oxidizing conditions. The Caron process has proved generally effective for the treatment of manganese-silver ores, and the only exceptions that have been found so far are ores containing antimony. Producer gas made from coal, coke, wood, oil or charcoal may be used, and all of the fuel can be gasified to meet the requirements of the reducing zone, the remainder being burnt directly in a combustion chamber between the preheating and the reducing units of the kiln. Although there are exceptions, most ores can be reduced in a coarse condition—that is, in sizes from one to two inches, and the best temperature of reduction is, in general, at some point between 500° and 700° C.

The Caron process can be most economically applied to daily tonnages of 200 or above, but for lower tonnages the cost of installation and operating would be somewhat greater. In a given locality the direct cost of the process would not differ greatly from the cost of dead roasting a low-sulphur ore.

Vickers' Metallurgical Enterprise in Rumania

VICKERS, LTD., have acquired an interest in a new metallurgical enterprise which has been formed in Rumania for the manufacture of armaments and machinery, according to a correspondent of the *Manchester Guardian Commercial*. The style of the company is the Copsa Mica and Cujir Metallurgical Company, with an initial capital of 300,000,000 lei, towards which public subscriptions have been invited in Rumania to the extent of three-tenths of the capital, the remainder being allotted to Vickers, Ltd., the Resitza Company of Rumania (in which Vickers, Ltd., are already partners), and the Rumanian Government.

Rust Prevention in Reinforced Concrete

To prevent rust and corrosion of steel reinforcement bars embedded in concrete, they can be dipped in sodium silicate solution and then dusted with pure dry Portland cement before placing in position and pouring the concrete, according to *P's and Q's*, an organ issued by the Philadelphia Quartz Co., Philadelphia. The alkalinity of the silicate prevents rusting and secures a strong adhesion between the bar and surrounding concrete. The process is cheap, and will prevent much crumbling of concrete now due to rusting and expansion of the steel.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

MAGNESIUM.—Production of metallic magnesium from fused salts. W. G. Harvey. *Chem. Met. Eng.*, June, 1925, pp. 573-576. Description of the electrolytic chloride and oxide processes.

The electrolytic production of magnesium (from melts containing magnesia). O. Ruff and W. Busch. *Z. anorg. u. allg. Chem.*, April 9, 1925, pp. 87-113 (in German).

CORROSION.—Zinc and the problem of corrosion. Part I. A. Billaz. *L'Ind. Chim.*, May, 1925, pp. 202-205 (in French). Discusses corrosion in general and introduces the subject of the corrosion of zinc.

IRON AND STEEL.—Contribution to the analysis of the shrinkage of white and grey cast iron. P. Bardenhener and C. Ebbefeld. *Stahl u. Eisen*; Part I, May 28, 1925, pp. 825-834; Part II, June 25, 1925, pp. 1022-1027 (in German).

The theory and practice of steel wire manufacture. A. Pomp. *Stahl u. Eisen*, May 21, 1925, pp. 777-786 (in German).

Heat treatment of cast iron. F. Grotts. *Trans. Amer. Soc. Steel Treating*, June, 1925, pp. 734-742.

Its effect on the physical properties of the iron.

Facts and principles concerning steel and heat treatment. Part II. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*. June, 1925, pp. 743-773. Explains the structures and properties produced by cooling steel at different speeds, discusses the various quenching media, and deals with the process of tempering.

Influence of temperature and chemical composition on the viscosity of iron. P. Oberhoffer and A. Wimmer. *Stahl u. Eisen*, June 18, 1925, pp. 969-979 (in German).

Stainless iron. H. S. Primrose. *Metallurgist*, May 29, 1925, pp. 74-77. A review of its manufacture, properties, working and uses.

Carburising and heat treatment of carburised objects. B. F. Shepherd. *Trans. Amer. Soc. Steel Treating*, June, 1925, pp. 774-789. Discusses the factors governing the process, the compounds employed, and the average works practice.

ALLOYS.—Aluminium foundry alloys. S. L. Archbutt. *Metal Ind. (Lond.)*; Part I, June 19, 1925, pp. 604-606; Part II, June 26, 1925, pp. 626-628. Reviews their properties, discusses age-hardening and heat treatment, and refers to their preparation.

The effect of artificial ageing upon age-hardened aluminium alloys. K. L. Meissner. *Metal Ind. (Lond.)*, June 26, 1925, pp. 623-626. Comparative tests between two alloys, showing that the properties are improved only in the case of the alloy containing copper.

Lead-zinc-antimony alloys and silver-tin amalgams. G. Tammann and O. Dahl. *Z. anorg. u. allg. Chem.*, April 9, 1925, pp. 1-39 (in German).

ZINC.—Investigation of the tenacity of zinc. G. Sachs. *Z. Metallkunde*, June, 1925, pp. 187-193 (in German). Tenacity and structure of cold-rolled zinc at ordinary temperature and that of liquid air.

ELECTRO-METALLURGY.—Electrical measurements in respect of metals of great purity. W. Geiss and J. v. Liempt. *Z. Metallkunde*, June, 1925, pp. 194-197 (in German). Preparation of tungsten, molybdenum and nickel, and determination of their specific resistance and temperature coefficient.

ANALYSIS.—Applied methods of estimating nickel in ores, slags, alloys, etc. *Metal. Ind. (Lond.)*, June 19, 1925, pp. 599-600.

Estimation of vanadium in ferro-vanadium and the red-green method. Dr. Koch. *Chem.-Zeit*, June 9, 1925, pp. 479-480 (in German).

Methods for the estimation of manganese in quality steel, with particular reference to the silver nitrate-persulphate method. Part I. A. Kropf. *Chem.-Zeit.*, June 23, 1924, pp. 517-520 (in German).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[***NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.***]

BENGAL IRON CO., LTD., London, S.W.—Registered June 9, £300,000 debentures (secured by trust deed dated May 29, 1925, supplemental to trust deed dated March 7, 1922); charged on property in British India, etc., also general charge. *£600,000. October 24, 1924.

CARTER (JAMES) (STALYBRIDGE), LTD., ironfounders.—Registered May 26, mortgage and charge, to bank, charged on Atlas Works, Stalybridge; also general charge. *Nil. December 3, 1924.

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd. Registered June 8, £500 debentures, part of £6,000; general charge; also registered June 8 (by order on terms), £10,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £3,000; general charge. *£3,859. July 24, 1924.

RODNEY FOUNDRY CO., LTD., London, S.E.—Registered June 4, £8,000 (not ex.) charge, to bank; charged on properties at Deptford, etc. *Nil. November 12, 1924.

WELCO PATENTS, LTD, BIRMINGHAM, steel manufacturers.—Registered May 29, £150 3rd debenture, to H. Jessop, 190, Aston Lane, Perry Bar, medical practitioner; general charge. *£210. September 7, 1924.

WEST (WILLIAM) AND SONS, LTD., Birmingham, metal manufacturers.—Registered May 25, £25,000 debenture, to W. West, 16, Caroline Street, Birmingham, metal manufacturers; general charge. *Nil. December 31, 1924.

Dolomite in the Cyanide Process

CALCINED dolomite (according to the U.S.A. Bureau of Mines Serial 2,648) has recently been sold as a substitute for lime in cyaniding gold and silver ores, the calcine being cheaper per ton than lime. In cyanide work lime is used for two purposes—to prevent loss of cyanide, and to cause precipitation of undesirable substances and flocculation and settling of ore slime. The primary object is to increase the extraction of precious metals. The results of experiments indicate that in regular cyanide practice, where cyanide solution is to be used repeatedly for extracting fresh batches of ore, the magnesium oxide content of calcined dolomite cannot be used advantageously to neutralise acidity. Where an excess of calcined dolomite is used to prevent the building up of magnesium salts in solution, the magnesium oxide content takes no part in the reaction. If just enough calcined dolomite is used to neutralise acidity, magnesium salts will build up and eventually form a saturated solution in which the cyanide loss would be high, unless an unusual amount of "bleeder" solution is run to waste.

In the cyanide treatment of certain ores calcined dolomite may be substituted for lime with profit. It is as effective as lime in preventing cyanide loss. It nearly parallels lime in its precipitating and settling effect and causes no difficulty in filtration of the solution or in the precipitation of silver and zinc. It equals lime in the quantity of precious metals recovered. In treating certain ores by the cyanide process the recovery of silver with the use of calcined dolomite as an alkaline agent is not equal to that obtained with the use of lime. The use of magnesium oxide content of calcined dolomite would therefore be confined to neutralising acidity and aiding settlement where the ore is crushed in water for amalgamation prior to cyanide treatment, and in cyanide practice where the solution could be discarded or "bled" sufficiently to keep down excess of magnesium salts. Calcined dolomite, it is added, should not be purchased as a substitute for lime in the cyanide process without a thorough investigation as to its action on the ore to be treated and its effect on all operations connected with plant practice.

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

The Manufacture and Applications of Nickel

By Maurice Cook, Ph.D., M.Sc., M.Inst.M.

The writer discusses the modern processes employed in the manufacture of nickel, the methods of working the metal, and the effects of the impurities commonly present. Attention is also drawn to those properties of the metal which have permitted its application to a number of different purposes, applications which seem likely to be considerably extended in the near future.

ALTHOUGH nickel in the form of a copper-nickel alloy was used for coinage purposes as long ago as 235 B.C., it was not until 1751 that nickel itself was isolated by Cronstedt. For about a hundred years after its discovery, nickel was not of any notable commercial importance, most of the small quantities of the metal produced being used largely in the manufacture of copper-nickel-zinc alloys, known as German silver or nickel silver, which were made as substitutes for a Chinese alloy of similar composition named packfong, which had long been known. The adoption of nickel in Swiss coinage alloys in 1850 helped the industry, which was further stimulated as other countries made use of the metal for similar purposes. In 1879 Fleitmann showed that the metal could be rendered malleable by the simple process of adding a little metallic magnesium prior to casting. In this way a metal which could be easily rolled and worked was produced. Nickel plating had become by this time a commercial process. A few years later, largely as a result of experiments in this country and in France, the advantages of adding nickel to steel became known, and in 1889 a paper was published by Riley in which the general properties of nickel steel were given. The material readily found commercial application in many directions, and as its properties and treatment became more perfectly understood, its use was greatly extended, until nickel steel is now the most extensively used of all the alloy steels. The advent of nickel steel gave a great impetus to the nickel industry, and thousands of tons of nickel are now consumed each year in the manufacture of this steel.

Nickel Ores

The two chief sources of nickel are the ores of Sudbury (Canada) and New Caledonia. The former is a sulphide ore and averages about 3 per cent. nickel and 1·5 per cent. copper, and the latter, which is an oxidised ore carrying no copper, contains 5 to 8 per cent. nickel. Sulphide ores are first roasted to reduce the sulphur content down to about 10 per cent., the operation being conducted in roasting furnaces, although the ore is sometimes roasted in heaps. From the roasted ore, a matte containing about 25 per cent. of copper plus nickel is produced in water-jacketed blast furnaces or reverberatory furnaces. This matte in the liquid state is transferred to a converter, where air is blown through it until the iron and most of the sulphur are oxidised, and the resulting Bessemer matte contains about 80 per cent. of copper plus nickel, the remainder being chiefly sulphur. At this stage the iron content should be about 1 per cent. There are three methods of refining or separating the copper and nickel of the matte. In the Mond process, which is worked in South Wales, the matte is roasted and the mixed oxide treated with warm dilute sulphuric acid. In this way the copper is partly removed and very little nickel is dissolved. The undissolved residue, which consists of nickel and copper oxides, is reduced to finely divided metal by water-gas. Carbon monoxide is passed over this in a volatilising tower at about 50° C., when the nickel, or a large portion of it, passes off as nickel carbonyl. This gas is decomposed by passing it over nickel shot heated to 180°–200° C. in a decomposing tower. The nickel is deposited on the granules, which are withdrawn when they have reached the desired size, and smaller shot is introduced into the tower. Nickel produced by this process is usually of a high degree of purity, 99·5–99·8 per cent. nickel.

The Orford Process

In the Orford process the matte is melted with crude sodium sulphate and coke. The sulphate is reduced by the coke to sodium sulphide, which forms a matte with copper sulphide of low specific gravity. The material in the furnaces is allowed to separate into two layers, which are either tapped separately or allowed to solidify in pots, when the lower portion containing the nickel sulphide can be easily split from the upper, which contains the copper sulphide. The nickel sulphide is roasted and leached with sulphuric acid to remove the copper present, and then reduced with charcoal in reverberatory furnaces. The metal is cast into ingots or pouretl into water to form shot, and sometimes it is cast into anodes and further refined electrolytically. In the Hybinette process, after the matte has been roasted to oxidise most of the sulphur, it is leached with 10 per cent. sulphuric acid, which extracts most of the copper. The residue, which contains about 65 per cent. nickel, is melted and cast into anodes, from which the nickel is obtained electrolytically. Silicate ores from New Caledonia are smelted in small water-jacketed blast furnaces with gypsum, to produce a nickel sulphide matte, and as this contains no copper, the nickel is easily obtained by roasting the matte and then reducing the oxide with charcoal.

There are several grades of commercial nickel, many of which contain well over 99 per cent. of the metal. Cobalt, copper and iron constitute the most frequently occurring metallic impurities, while carbon and sulphur are the most common non-metallic impurities. The metal is marketed in the form of cubes, rondelles, shot and ingots. Nickel which has been deoxidised prior to casting, and known as malleable nickel, is marketed as sheet, wire, tubes, rods, etc.

Malleable Nickel

Nickel as ordinarily obtained cannot generally be worked. Fleitmann's discovery that the addition of about 0·1 per cent. magnesium just before casting produced a malleable metal was of very great moment, and this method of producing malleable nickel is in general use to-day. Until very recently it was thought that the magnesium acted primarily as a deoxidiser, but it would appear from the work of Merica and Waltenberg on this subject that its chief function is to break down the nickel sulphide, Ni_3S_2, which occurs as films around the nickel crystals and renders the metal brittle, both in the hot and cold state, to produce the much less harmful compound magnesium sulphide, MgS. This is insoluble in molten nickel, and freezes as small particles before the metal itself. These are trapped in the molten metal during solidification, and so occur disseminated throughout the mass and not as films at the grain boundaries, in which form they exert no deleterious effect on the malleability of the metal. Manganese is used as an addition in the production of malleable nickel, but it is not nearly so efficient as magnesium. Manganese has a higher affinity for sulphur than nickel and forms manganese sulphide, MnS, which separates along the grain boundaries, not as surrounding films, but in small globules. In this form the sulphur is not so harmful as when occurring as Ni_3S_2, and thus manganese, although not making the nickel perfectly malleable, improves this property considerably.

In the production of malleable nickel for castings, or for ingots to be subsequently worked into tubes, sheet or wire,

it is a common practice to add manganese and then magnesium to the melt before casting. The metal can be melted in crucible, electric or open-hearth furnaces. It is important to keep the metal as free as possible from impurities, and as sulphur is an impurity which in very small amount seriously impairs the malleability, contamination with this element must be specially guarded against. The carbon content of the original nickel is a variable factor, and will depend on the method used in reducing the metal. It is brought down to about 0·1 per cent., if it is much in excess of this figure, by the addition of nickel oxide. The nickel which melts at 1,452° C. should be poured between 1,550° and 1,650° C. The magnesium, as well as altering the state in which the sulphur occurs in the metal, exerts a strong deoxidising influence. Owing to its lightness, the magnesium, if it is to fulfil its functions adequately, must be plunged with tongs well below the surface of the metal. The production of malleable nickel from commercial nickel is a comparatively simple process which can be carried out in any foundry with facilities for melting the metal. Since the material "pipes" to a considerable degree, it is essential in the manufacture of castings to provide ample gates and risers. The shrinkage allowance is a quarter of an inch to the foot, and the castings should be made in baked moulds. In the production of castings in nickel, other than malleable nickel, the "deoxidising" treatment with magnesium is dispensed with.

When oxygen occurs in nickel it does so in the form of nickel oxide. In malleable nickel it is not usually present. The oxide forms an eutectic with nickel containing 1·1 per cent. NiO or 0·24 per cent. oxygen and melts at 1,438° C. The melting point of the oxide itself lies between 1,650° and 1,660° C. Prior to the work of Merica and Waltenberg, it was believed that oxygen in the form of NiO was responsible for the lack of malleability, but the same workers have shown that nickel containing oxide up to the eutectic composition is quite workable, both hot and cold. No other systematic work on the influence of oxygen appears to have been carried out.

Sulphur occurs as nickel sulphide, manganese sulphide or magnesium sulphide. In the absence of manganese and magnesium the sulphur does not render the nickel non-malleable unless it exceeds 0·005 per cent. As previously pointed out, manganese partly, and magnesium wholly, restores the malleability of nickel containing more than this limit of sulphur. It has been shown that magnesium can render quite malleable nickel containing 0·25 per cent. sulphur, which is many times in excess of the amount usually found in the commercial metal.

Presence of Impurities

Cobalt is a common impurity, but it is without any marked effect on the mechanical properties of nickel. In the relatively small amounts in which silicon is likely to occur in furnace-refined nickel, it does not produce any harmful effect. Manganese, being usually added to the metal in addition to magnesium in the production of malleable nickel, is generally found in that class of material, but not, as a rule, in ordinary nickel. As well as being of service in that connection, manganese is frequently added to enhance the mechanical properties and facilitate the production of castings. It increases the fluidity of molten nickel and also possesses the advantage of decreasing the possibilities of hot cracking. The amount necessary need not exceed 1-1·5 per cent. To produce decided improvements in the mechanical properties and increase the resistance to oxidation, more manganese is necessary. Like cobalt, manganese is soluble in nickel in all proportions in the solid and liquid state, and, as is the general case with a metal held in solid solution, very appreciably decreases the electrical conductivity.

Iron being an element generally associated with nickel ores, its occurrence as an impurity in the refined metal is to be expected. Usually it is below 1·0 per cent., and in most commercial grades does not exceed 0·5 per cent. In these amounts it is without appreciable effect on the mechanical properties. Since iron is soluble in solid nickel, this impurity cannot be seen in the microscopic examination of the metal. Copper is another commonly occurring impurity which is held in solid solution. This element is generally found in small amounts only, ·01 to 0·1 per cent., and does not constitute a harmful impurity.

Carbon has been looked upon as a necessary impurity in nickel, not because it is in itself a desirable element to have present, but because it is considered a lesser evil than nickel oxide. It is usually found in small amounts only, not more than about 0·15 per cent., in which quantity it occurs in solid solution and tends to harden and strengthen the metal. The presence of more carbon hardens the metal still further, and renders it difficult to work cold. If more than 0·4 per cent. is present, the malleability suffers owing to the separation of graphite.

Mechanical Properties

The mechanical properties of cast malleable nickel, like those of most other metals, are considerably improved on working. The cast material should give a yield point of 10-12 tons per square inch, and ultimate strength of 22-25 tons per square inch, and an elongation on two inches of about 25 per cent. In the form of hard rolled sheet the ultimate strength reaches as much as 50-55 tons per square inch, with a correspondingly high yield point. Nickel maintains its tensile strength at temperatures up to 400° C. or 450° C., after which the deterioration is very rapid. At ordinary temperatures the Brinell hardness number of nickel in the annealed state, using a load of 3,000 kg., varies, depending on the extent and nature of the impurities present, between 90 and 120. The value of Young's modulus varies between 13,335 and 14,605 tons per square inch. The thermal conductivity of nickel is 0·142 in C.G.S. units at ordinary temperature. The value changes at higher temperatures and there is a sharp break in the temperature-conductivity curve at about 700° C. The electrical resistivity at 0° C. is 6·4 microhms per c.c., and the temperature coefficient 0·0066 between 0° and 100° C. Although it cannot be said from the evidence available that there is an allotropic modification of nickel, the metal undergoes a distinct magnetic transformation in the region 340° to 360° C. There is a change in the electrical resistivity-temperature curve also at this point and a distinct change in the temperature coefficient value. On the other hand, the curve of thermal expansivity is without any irregularity at this temperature. The density of malleable nickel averages about 8·84, which corresponds approximately to 552 lb. per cubic foot or 0·319 lb. per cubic inch.

Methods of Working

The correct temperature to which nickel should be heated before hot rolling or forging is 1,100-1,200° C. As the metal is inclined to be hot-short at higher temperatures it is important that 1,200° C. should not be exceeded. It has been found that the metal forges better under the hammer than in a press. The method of manufacture of seamless tubes of nickel is similar to that employed in the case of copper, brass and steel, except that the degree of reduction between each drawing is smaller, which increases the total number of drawing operations.

The correct annealing temperature for worked nickel lies within the range 750°-900° C. It has been shown that the annealing temperature is quite independent of the degree or amount of cold work which the metal had undergone. Further, after annealing the metal may be slowly or quickly cooled as desired, for alteration in the rate of cooling is without effect on the properties. Close-annealing is preferable in order to avoid the formation of oxide and subsequent pickling, which in the case of nickel is a troublesome and tedious process.

Of the world's output of nickel, some 60 per cent. is consumed in the manufacture of nickel steel, and about 25 per cent. is used up in the production of nickel silvers, and cupro-nickel alloys. About 5 per cent. is used in the form of malleable nickel and the remainder is divided between anodes for plating and miscellaneous purposes.

Although nickel is employed far more extensively in the form of alloys than as the pure metal, amongst these being some of the strongest and toughest non-ferrous alloys known, as well as those possessing remarkable heat-resisting properties, it finds considerable application in view of its many highly desirable properties. Malleable nickel is produced in the form of sheet rods, strip wires and tubes. Forgings of various classes and automobile radiators are also made from this material. It has a pleasing colour and appearance, and resists the action of air and fresh and salt water extremely well. Another useful property, which accounts for the adoption of the metal in many instances, is its ability to withstand oxidation in air up to temperature approaching 500° C., when it is only slightly oxidised.

Solutions of alkalies or fused alkalies do not effect the metal, and for this reason it is used for laboratory ware of certain kinds. It is only attacked by organic acids after long periods of contact, but mineral acids dissolve it, nitric acid doing so much more readily than either hydrochloric or sulphuric. Its appearance and its resistance to wear and abrasion make it a suitable metal for coinage purposes, for whilst it is sufficiently hard to resist defacement, it is malleable enough to be easily minted and sensitive to the die. It is preferable to most nickel-coinage alloys in this connection, which oxidise more readily and when the coins are worn they have an unattractive yellow appearance. More than 70 countries and dependencies use nickel or nickel alloys for coinage purposes, and there is a definite tendency to utilise the metal more extensively and preferably in the unalloyed state.

It resists corrosion by foodstuffs extremely well, and is used for cooking utensils, and its non-toxic properties enhance its value for this purpose and also for the dairy industry. Various ornamental stampings and fittings are now made of nickel. Nickel tubing is used for condenser tubes, domestic water heaters and a variety of other purposes, while nickel wire finds application in the electrical industries. The metal can be readily welded by either of the processes, oxy-acetylene welding or electrical resistance welding, but it cannot be smith-welded, for the coat of nickel oxide formed cannot be fluxed. It can be soldered and brazed by the ordinary methods. In recent years the applications of nickel have been greatly extended and, as its many useful properties become more generally known, it will undoubtedly find increasing use.

Notes on the Examination of Metal Fractures

Practical Determination Properties

THE examination of fractures was at one time considered among the most reliable means of ascertaining the quality of a metal, but nowadays a certain amount of ignorance of the subject exists, largely owing to more accurate scientific methods having superseded it. Chemical analysis is seldom applied in general engineering practice as a means of finding out the defects in metals, and of late years the examination of the structures of metal is coming into great prominence. As this latter entails the cost of a microscope and someone to operate it, only a few of the more modern engineers use this means of testing. Those who have had much experience in examining fractures by the naked eye can gain a considerable amount of information as to the variety of metal they are dealing with without need for microscopical or chemical tests.

The examination of the fractures of broken test bars is not of such great value as the examination of metal which has broken down unexpectedly. These pieces of metal which have broken down should be collected, classified, and kept for further reference. If a few of them are periodically sent out for chemical or microscopical examination, and a comparison made of the different fractures, very valuable information can be secured. Although examination with the naked eye is not always to be relied on, it is often sufficiently accurate to give a fair indication of the physical properties of the metal. For example, if a metal shows a fine silky fracture it will be homogeneous and ductile, even though the structure may be coarse. If the fracture be more fibrous than silky it is due to a small percentage of a brittle material which exists between the crystal grains of a ductile metal. When the fracture is vitreous or glassy it indicates a brittle metal, usually possessing a fine structure.

Characteristic Fractures

Cast metals with little ductility (cast iron, etc.) show a granular fracture, and the scale of the fracture resembles the scale of the structure. The surface of the rupture in these instances passes along the granular boundaries, and in some cases through the grain, the fracture usually appearing dull. A crystalline fracture also indicates a brittle metal, and the scale is often different from that of the structure, being bright instead of dull. These examples of characteristic fractures cannot always be depended upon to show up defects and weaknesses, particularly when dealing with different classes of metal, but when one or two classes only are being examined, experience will prove that they give reliable evidence of the physical properties. The examination of the fracture is best conducted by use of an ordinary magnifying glass. A microscope is not so suitable for this variety of work, as the roughness of the fracture causes difficulties in illumination and focussing of the specimen. The microscope is extensively used in research laboratories for examination of polished and etched samples of metal, as a rapid method of obtaining approximate chemical analysis. Besides detecting the presence of impurities, flaws, etc., the microscope can be used to find their extent and variety. As is well known, a knowledge of fractures is particularly useful in distinguishing grey, white and mottled irons from one another. When cast iron is slowly cooled, a large proportion of the carbon separates out in the graphitic state, thus giving the fracture a dark grey colour. If the same metal be chill cast, this graphitic separation is held up, the carbon remaining in the combined state, and the fractured surface of the metal being bright and white. By varying the rate of cooling an intermediate variety known as " mottled cast iron " is obtained, which shows a fracture of mixed grey and white iron. Although analysis is now largely relied upon to ascertain the composition when buying pig irons, different grades are determined by the appearance of the fracture. Different works have their own methods of grading pig irons, but as a general rule the low numbers have an open grain fracture and the high numbers a close grain. When the grain is large and open the metal usually contains a high percentage of silicon. A small and close-grained iron contains a much smaller proportion of silicon. The open-grained metals are usually soft, and the close-grained irons very much harder.

Non-Ferrous Metals

The examination of the fractures of the different brasses is a study in itself, and the subject has been dealt with in detail by several prominent metallurgists. When copper is being refined, the purity of the metal is determined by melting a small sample with different proportions of zinc, breaking the brass formed and examining the fractures. The purity of zinc can also be estimated by examination of the fracture. If it be bright, open and large in grain, only a small proportion of iron is present, but when grey, close and small in grain iron may be present up to 7 per cent. This test is a useful guide to buyers offering quotations for large consignments of mixed zinc scrap.

The transformations which occur when metals are cooled from different temperatures can be noted by careful examination of fractures. For example, when white brasses are broken hot they have a columnar appearance. If the same metal be broken cold, the fracture is crystalline or finely granular. Most of these transformations take place while the metal is in the molten condition, but when they occur in the solid state they can readily be detected by the difference in the fracture. In some instances a crystalline fracture is produced by prolonged hammering with some metals. Continual vibration and sometimes intense cold are known to change the structure of certain metals to the crystalline state. If tin be allowed to fall some distance on the point of melting, a columnar structure is produced.

In examining the structure of ingots of antimony, the temperature and conditions under which it has been poured should be taken into account. If the metal be allowed to set without the surface being covered, or if the slag covering set before the metal, the characteristic " star " of antimony will get broken up. Up to the present time few, if any, tradesmen have paid much attention to the fractures of metal with which they are working, and when breakdowns or accidents occur they are looked upon more or less as mysteries. A still more surprising feature is that many chemists, thoroughly experienced in analytical and microscopical work, possess a very limited knowledge of fractures, particularly with regard to the non-ferrous metals.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Aluminium as a Coating

A THESIS of no little interest was recently presented by an American Engineering student, Mr. E. D. Martin, to the Faculty of Sciences at Nancy. It was entitled "A Contribution to the Question of Coating Metals by Other Metals or Alloys," and it has attracted favourable notice in the foreign technical press as a valuable précis of its subject. So far as aluminium, with which the thesis is principally concerned, is involved, the author has taken as the basis of his investigations the iron-aluminium diagram proposed by Guertler. He points out, however, that the information to be derived from that diagram is lacking in certain very important particulars. With regard to the employment of aluminium as a coating for other metals, the question of diffusion, its rate, the surface tension of adjacent grains or crystals, and the influence of temperature on these factors are paramount considerations. Carbon is insoluble in an iron-aluminium solution. The pearlite of steel therefore resists adhesion to the eutectic and its derivatives. The phenomena of diffusions are what really determine the adhesiveness of a protective coating. Tinning is not dealt with in Mr. Martin's thesis but sherardisation (coating with zinc), calorisation (coating with aluminium) and chromisation all come in for discussion.

A New Method

AFTER dealing with various methods, besides calorisation, for using aluminium as a coating, a new method invented by the author himself is described. It is a modification of the calorising method. For the obtaining of successful results it is necessary that ammonia salts and aluminium should be simultaneously present. The reaction which takes place is a reversible one, and may be expressed thus :—

$$3Fe + 2AlCl_3 \rightleftarrows 3FeCl_3 + 2Al.$$

The direction of the reaction depends upon the temperatures at which it takes place. It would appear that the aluminium chloride, at the temperature employed, is due to the action of the decomposing ammonium chloride, and the resulting nascent chlorine, and is therefore in a more active condition. To come to the more practical results obtained, iron coated with aluminium by the process suggested is resistant to atmospheric agencies but not to acid attack ; the coating is perfect, free from cracks and strongly adherent ; and it is devoid of porosity. The considerations which led to the perfectioning of this process may be carried further, and a general law deduced. In regard to any two metals, A and B, it is necessary only to chose an electro-negative salt C which will form, with either metal, a salt volatile at high temperatures and in respect of which the following equation, which must be reversible, holds good :—

$$\underset{\text{Solid.}}{A} + \underset{\text{Gaseous.}}{BC} \rightleftarrows \underset{\text{Gaseous.}}{AC} + \underset{\text{Solid.}}{B}$$

In this form, and given the proper temperature, the reaction applies equally to the coating of copper with aluminium.

Fatigue in Railway Tyres

JUDGING from the newspapers, tyre troubles are more common abroad than in this country although not long ago an accident which could probably be traced to this cause occurred on one of our Northern lines. The considerations which govern the manufacture and construction of locomotive and carriage and wagon wheels are, to a considerable extent, empirical, and hence it is usual to allow a very large margin of safety. A highly interesting contribution on the subject of fatigue in railway tyres, by P. Billet and H. Wantz, with an appendix by C. E. Guillaume, which has appeared in a recent number of our French contemporary, the *Revue de Métallurgie*, will therefore be especially welcomed by railway engineers and metallurgists generally. The proper adhesion of a tyre to its wheel is governed by a number of considerations, some of which it is not easy to reconcile in practice. The dilatational properties of a tyre have, of course, to be brought into play, but in proportion as they are excessive, owing to the tyre having been overheated, they secure firmer adhesion at the expense of setting up severe stresses, thus inducing premature fatigue, with its consequent dangers, in the metal of the tyre itself. On the other hand, if it be sought to eliminate these stresses by heating the tyre only to the extent necessary to secure a degree of unstressed adhesion, it will tend to work loose, or may fracture owing to impact shocks, and in other ways prove more dangerous still.

Solid Wheels

AN important factor is the condition of the metal forming the wheel centre or hub. If this be fairly elastic it will tend to take up and compensate for some of the stresses due to a very tightly fitting tyre. The arguments deducible from these considerations support the view that safety is best attained by using solid wheels, wheels, that is, made in a single piece, and with specially hardened treads. In practice the solution is not, however, found to be as simple as this. The investigations undertaken by Billet and Wantz bore therefore on the two main factors concerned : (1) a mathematical study of the elastic stresses in tyres, and (2) the experimental determination of the elasticity of hubs of various descriptions and metals. Their conclusions are that the solid wheel is, after all, the only one from which the best and safest results can be obtained ; the conflicting requirements in the case of wheels having a separate tyre shrunk on to them being such as inevitably to occasion possible dangers. So far as French practice is concerned, the authors recognise that experience in the manufacture of solid wheels is lacking ; moreover, the problem becomes an economic one rather than a question of engineering or metallurgy alone. A full account of the experimental methods on which the conclusions are based and illustrations of the appliances used in determining the elasticity of the wheel centres, and the fatigue stresses in the tyres, accompanies the article, and will well repay detailed perusal.

Japanese Investigations of Duralumin

FROM some interesting tests carried out at the Tohoku Imperial University of Japan, it appears that in quenched duralumin the softer the quenching the more the immediate effect of hardening increases, and that its ageing effect, as well as its final hardness, decreases. When quenched in oil at 100° or higher temperature the ageing effect vanishes altogether. Conversely, the harder the quenching the more the immediate effect decreases, and the ageing effect and the hardness increase ; the maximum values in this case being obtained by quenching duralumin from 500° in water. It is also concluded that the above effect of quenching is due to the dissolution of copper and magnesium compounds in aluminium, the process of separation or dissolution being extremely slow. Thus it appears that duralumin is in a hardened state even if cooled very slowly from 500°.

Alloys of copper and aluminium indicate by quenching an immediate hardening effect, but show only very slightly the effect of ageing. The immediate effect is partly due to the dissolution of Al_2Cu in aluminium, but the principal cause of the ageing effect of duralumin cannot be ascribed to that compound. In the alloys of aluminium and magnesium containing about 1 per cent. of magnesium the immediate effect of quenching is always very small, but the ageing effect is as great as that of duralumin. The ageing, as well as the immediate effect of quenching the alloys mentioned here, is attributable to the dissolution of Mg_2Si in aluminium, but not of metallic magnesium. This is because, if the magnesium increases above 1 per cent. the above two effects begin to diminish, and with an increase of above 3 per cent. of magnesium they almost vanish entirely. An addition of both magnesium and silicon in the proportion of the compound Mg_2Si increases the same effects. It is, of course, well-known that a small quantity of silicon is always present in aluminium as an impurity. It appears that the addition of about 4 per cent. of copper and a small quantity of manganese, not over about 0·5 per cent., to the alloys of magnesium and aluminium will increase the hardness but not the ageing effect. Quenched duralumin expands at ordinary room temperatures as ageing proceeds, which is the case in quenched low-carbon steels.

Krupp's Steel Works

ABOUT one-third of the goods produced by Krupp's steel works at Essen are for export, according to a correspondent of the *Manchester Guardian Commercial*. Rolled steel, steel bars, and wire are being exported to England, while orders for girders for Indian and South African railways are being executed. Herr Baur, who is the oldest member of Krupp's board of management, has expressed himself in favour of the consolidation of parallel industries by means of "cartels," and supported international understandings between Germany, France, England, Belgium, and Luxemburg in the iron and steel industries.

Before the war the works in Essen employed 43,000 men. Normally it is reckoned that they should now employ 50,000, but at present the number at work is 36,000. The steelworks in Rhinehausen, 14 miles away, are working at normal capacity, employing about 8,500 men, as there has recently been an increased demand for steel. The unemployed in Essen in receipt of public assistance number 8,000. As Essen is a city of half a million people—the Sheffield of Germany—this compares favourably with the unemployed in Sheffield, numbering about 24,000. Krupp's started some time ago the manufacture of textile machinery, but the textile industries in Germany are at present in a depressed condition. A new factory, built during the war, has been transformed into locomotive works. The first locomotive was turned out in December, 1919. Since then 770 locomotives have been built and 8,000 goods waggons, but the manufacture of locomotives and waggons is to-day practically at a standstill.

Titanium Ores in Blast Furnace Practice

IN these days of specialisation, " one man one metal " would appear to be the rule. There are advantages in such an arrangement; there are also manifest disadvantages. The habitat and behaviour of individual trees are minutely studied, but their relation to other trees, often a very important point, tends to be ignored; the forest itself is overlooked. These remarks are prompted by a review, which has appeared recently in a foreign contemporary, of the life work of Auguste Rossi, a distinguished American metallurgist of French extraction, whose energies and research have been devoted almost wholly to titanium. The review, incidentally, raises the question of the influence of titanium in steel. There are some who regard it as an oxidiser, pure and simple. In the ordinary way there is no doubt that titanium performs this function. It is not to be denied, on the other hand, that titanium steel exists. The point where the elimination of oxygen — and probably of other impurities—ends and where combination takes place, is obscure; the iron-titanium diagram has not been thoroughly explored. The chemistry of titanium is fairly simple; its presence in iron-bearing minerals widely distributed. An electrical method for treating iron sands is being actively canvassed in this country at the present time. In the interim, it is of interest to know what an acknowledged authority like Mr. Rossi has to say on the subject. In the blast furnace, the treatment of titaniferous iron ores would appear to depend on the right selection of fluxes. Titanium silicates are of acid nature; with the proper proportions of bases such as alumina, lime, and magnesia, fairly fluid slags are obtainable. Dolomite is recommended, and in a specially designed blast furnace the titaniferous ores of the Adirondacks, containing 55 to 56 per cent. of iron and 10 to 12 per cent. of TiO_2 have been successfully smelted, and excellent pig iron containing but traces of titanium obtained. Sometimes, however, as much as 1 per cent. of titanium remains in the pig iron, which in such cases is exceedingly white and hard.

Ferro-titanium and Titanium Steel

A WIDE range of ferro-titaniums can be obtained in the electric furnace. The higher the titanium percentage the less fusible are these products. This notwithstanding that ferro-titanium with 80 per cent. and even more titanium can be obtained. The drawback to the more general employment of these ferro-titaniums is that the percentages of carbon are apt to be high. Rossi has, however, succeeded, by using molten aluminium as an admixture in the bath of his electric furnace, in getting the carbon down to as low as 0·12. The resulting product contains amounts of aluminium too small appreciably to affect its behaviour as an adjuvent to steel. The process is also applicable to the preparation of ferro-tungsten alloys. It is somewhat wasteful, however, of aluminium, only part of which is recoverable. The price of the low carbon alloy is far higher than that of the normal 7 per cent. carbon alloy, which contains, however, less titanium; on the average, 15 per cent. of this element is guaranteed. The product is very hard, and is therefore sold in lumps, graded as to size, to suit the buyers' requirements. When added to steel such ferro-titaniums eliminate both oxygen and nitrogen, and in the case of the latter element, what is not actually eliminated is rendered harmless by forming minute titanium nitride inclusions which, it is claimed, are innocuous. A very small amount of titanium, in the proportion of only 0·05 per cent. of the mass treated, suffices to effect its beneficial action. Any excess is eliminated. Titanium nitride, if formed, does not segregate but becomes evenly and harmlessly distributed through the mass of metal. While it is possible, according to Rossi, to make titanium steel with as much as 1·10 per cent. of titanium, the affinity of the metal for oxygen is such that, in practice, more than 0·025 per cent. is never met with. This amount is too small to affect the properties of the steel; the improvement which the use of titanium produces in the quality of such material is due, therefore, solely to its action as a purifier. The so-called titanium steel rails, of which much has been heard of late, only contain 0·011 per cent. of titanium. In other respects, however, such rails give remarkably good results in practice.

Tool Steels Containing Cobalt

IT is sometimes said, not without truth, that the Japanese, who are indefatigable workers on metallurgical subjects, initiate little new work, but meticulously go over and over ground which has been thoroughly worked by European and American investigators. There is sufficient truth in the statement to warrant some satisfaction in finding that K. Sasagawa's researches on cobalt tool steels are not a mere repetition of Professor Guillet's previously published work on these alloys. They have, in the present instance, been made with a view to studying the effect of a cobalt addition to the dilatometric properties of tool steels containing the usual percentages of chromium, tungsten, vanadium and wolfram, the addition amounting to 5 per cent. of cobalt. The hardness and microstructure of such a steel is compared with the hardness and microstructure of otherwise similar steels not containing any cobalt. The presence of this element was found, generally speaking, to lower the hardening temperature, as compared with an 18 per cent. tungsten steel, but as the cobalt containing steel had only 10 per cent. of tungsten, the reasoning can hardly be accepted as conclusive. Cobalt steels are credited with four transformation points; but here again it has to be remembered that only one such steel was experimented on. The fourth transformation is said to relate solely to the cobalt itself, and to take place at about 770° C. The cobalt steels are mainly of interest owing to their magnetic properties, which are in process of being pretty thoroughly explored by other workers. Mr. Sasagawa's work has the merit of being fairly original, but it is based on somewhat insufficient data.

The Institute of Metals

THE programme of the annual autumn meeting of the Institute of Metals, which is to be held in Glasgow from September 1 to 4, begins with a lecture by Sir John Dewrance, K.B.E., on " Education, Research, and Standardisation." The mornings of September 2 and 3 will be devoted to the reading and discussion of no fewer than sixteen papers dealing with many aspects of metallurgical work, and among the communications which are expected to be submitted are :—" Colloidal separation in alloys," by Professor J. H. Andrew; " The influence of pouring and mould temperature on properties of a lead-base anti-friction alloy," by Professor O. W. Ellis, of Toronto; " Zinc-copper alloys," by Dr. M. L. Gayler; " The primitive copper industry of America," by Mr. G. B. Phillips, of Philadelphia. In the afternoons visits will be paid to works in the Glasgow district, and in the evening of September 2 a reception is to be given by the Lord Provost and Corporation of Glasgow. The concluding day of the meeting, September 4, is set apart for a visit to the Trossachs and Loch Lomond. The secretary of the Institute, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, will supply details of the arrangements, and of membership election to be completed in time for the meeting.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

WHATEVER else may be said of the month of July, it has not lacked interest. The orders for steamers for the Blue Star Line, the Admiralty programme for new cruisers, the question of subsidies and, above all, the possibility of a coal strike, have provided ample material for discussion in the newspapers and in business circles.

The most serious matter is the coal crisis. The merits and demerits of the arguments on both sides are outside the province of this article, and have been ventilated quite enough elsewhere. The dispute must eventually be settled by conference and it is a tragedy that so often, as in the present case, this only method of arriving at a reasoned agreement is delayed until the eleventh hour when all the misery and disaster consequent upon a stoppage is impending. An interesting situation is created by the fact that the South Yorkshire colliery owners have decided not to issue notices to their men, but to leave them free to continue working on the old terms. The decision of the transport workers to support the miners by refusing to move any coal strengthens the hands of the extremists and lessens the hope of an early settlement.

Steel Subsidy Question

What is the position of the iron and steel trade in all this? Conditions are, and for a long time have been, bad enough without any unnecessary obstacles being put in the way, but industrial stoppages are becoming so much a part of the general order of things that one begins to despair of the future. Every year, hundreds of thousands of pounds are lost both to employers and workmen by strikes and lock-outs which seldom achieve any good purpose, and for more than one undertaking another stoppage might well be the last straw. In the inquiry which is at present being conducted one intelligent question asked was, "How long can a colliery go on losing money?" and, indeed, many individual firms in the coal and in the iron and steel industries are asking themselves in all seriousness the same question. The question of subsidies or a tariff for the steel trade is still being debated and numerous references to it have been made in Parliament. It is more and more doubtful whether anything will be done. The two sides, for and against, have each strong arguments in favour of their attitude, and their interests are so opposed that there seems little chance of a compromise. The steel maker points to the loss of work which he suffers owing to the importation of foreign steel; the re-roller maintains that by purchasing this steel he is providing employment for a large number of men and that, if he is compelled to buy British steel at the higher price, the steel maker will be no better off, as the foreigner will then send in the finished bar instead of the semi-finished steel at prices which we cannot touch. There are also grave difficulties in the way of subsidies. Further consideration shows that the proposal to use the money now being paid in unemployment benefit as a subsidy to enable the employers to keep the men in work is not all plain sailing. One serious drawback is that it would penalise the more efficient firms, particularly those who have carried on at a loss in order to provide work, while it would give the advantage to the less efficient plants. We had sufficient experience of this kind of thing in the war, and its ill effects have not yet passed off. Work, more work, is still the only solution.

Cruiser Construction

The decision of the Government to proceed with the construction of the new cruisers, although received with mixed feelings by the country at large, is welcome news to the steel trade. With the present huge burden of expenditure which the country has to face annually, it is not surprising that there are misgivings about this additional charge, but there is some compensation in the abandonment of three of the old dockyards, with the resultant decrease in expenditure. At all events, the Admiralty work will give a little fillip to the steel trade. In pre-war days, a good Admiralty programme was always coincident with good trade in the steel works and in the country generally. The present programme is not extensive, but it may impart a little life to our languishing industries.

Speaking of ships, the orders from the Blue Star Line are a very appreciable addition to the order books of the shipbuilding firms and of the steel makers who are to supply the steel. Three of the boats are to be built at Birkenhead by Cammell Laird and Co., and two at Clydebank by John Brown and Co. Unfortunately, the builders and the steel makers cannot hope to make much out of the contract. The price had to be cut in order to keep the order in this country, and the steel works will certainly not pay a dividend out of their share of the work. The sections have been placed at less than £7 10s. per ton delivered, and one of the North-East Coast makers has taken the order for the plates at a price very close to £8 per ton delivered, with a carriage of not less than 10s. per ton, even if delivery is made by water!

Trade Inactivity

Market conditions during the month have really not been any better than before. There has been a little activity, due to the desire of some firms to make provision against the possibility of a coal stoppage, but there is no actual improvement in trade. There is little or nothing doing in pig iron, both foundry and hematite. The latest addition to the list of firms closing down is the Trent Iron Co., who have stopped their furnaces at Frodingham. Even the low prices which are ruling do not tempt business, and the tendency is downwards. The hematite trade is in a worse position than it has been for a long time. There are less than a third of the usual number of furnaces in blast, the makers finding it preferable to damp down the furnaces and sell their stock, rather than go on making iron at present prices. The bar iron trade has not benefited to any extent by the recent reduction of 10s. per ton in the selling price. There are not many orders on the books and expectations are not great in view of the holiday season and the labour troubles.

The steel trade can tell no better story. Every order that comes on the market is fought for, and the prices we have mentioned for the shipbuilding orders show how far the makers are going in the cutting of quotations. For plates £9 is now considered quite a good price, and for an order for 100 tons or even less there is no difficulty in getting a quotation as low as £8 10s. delivered. Sections are about 20s. less than this. The price for acid billets has just been reduced 10s. per ton, whilst basic billets, both hard and soft, can be bought well below the Association prices. There are hopes that when holidays are over and the coal trouble settled there will be a definite improvement in the iron and steel trade generally. The output of pig iron in June amounted to 510,300 tons, compared with 574,700 in May. The number of furnaces in blast has decreased by nine. The steel output is 585,400 tons, which is the smallest monthly total this year. The May figures were 651,600 tons.

Steel Industry Abroad

REPORTS state that the Government of India has decided to ask the Tariff Board to institute an immediate inquiry with the object of ascertaining if the protection afforded to the steel industry by the Tariff Act will need supplementing by a bounty after September, when the existing bounty ends. If it is decided that the industry needs further assistance the Board has been instructed to determine the extent and form of that assistance and the articles which require it.

The Swedish Iron Office has decided to grant a subvention of 25,000 kr. (about £1,420) to the Uddeholm Company for the experimental production of steel direct from iron ore according to the process devised by the engineer M. Flodin. The Office has also under consideration an application from the Sandviken ironworks for a subvention towards the exploitation of another process devised by the engineer M. Martin Wiberg. The Grängesberg concern reports that the shipments of Swedish iron ores from the company's ports in January of this year totalled 502,000 metric tons, compared with 214,000 tons in January, 1924. The shipments last December totalled 543,000 tons, as against 144,000 tons in December, 1923.

Some Inventions of the Month

By Our Patents Correspondent

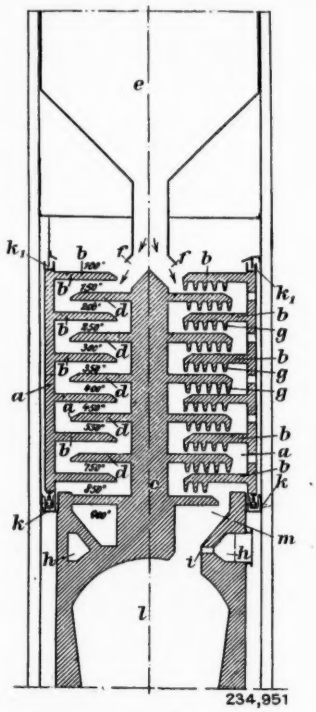
Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Briquetting Ores

ACCORDING to a patent application by A. Carlson, of Degerhamn, Sweden, purple ore, burnt pyrites, etc., are mixed with 2–3 per cent. of burnt lime, pressed into briquettes, and hardened by steam. Fine ores or concentrates may also be included in the briquettes. See Patent Application 233,731, having the International Convention date, May 10, 1924.

Reducing Iron Ores

J. G. AARTS, of Dongen, Holland, has patented an oven for treating iron ores, which avoids the disadvantages of the blast furnace due to the height of the furnace and the local inequalities due to the large lumps of ore and coke with which the furnace is charged. A rotary casing *a* carries a number of horizontal annular platforms *b*, and a fixed central standard *c* carries similar platforms *d* between the platforms *b*.



The usual charge is supplied through the funnel *e*, and is gradually moved downwards over the platforms due to the raking action of the teeth *g* which turn the material over and move it toward the edges of the plates. Reducing gases are supplied to the oven through the channel *h* and ports *i*, and move over the ore in counter-current. The temperature is kept below 1,000° C., so that no melting or fritting takes place, and the reduced iron is of spongy structure and fine grain, and must be prevented from reoxidation. Finely divided ores can be treated in this oven. See Patent No. 234,951, dated April 10, 1924.

Magnesium

APPLICATION for a patent has been made by B. E. F. Rhodin, of New York, for a process for obtaining pure magnesium from crude magnesium, or from alloys of magnesium with a metal such as zinc which will react with alkali. The alloy is treated in a bath of molten caustic soda, which removes the zinc. The crude magnesium may have zinc added to it and then be treated as above. See Patent Application 234,074, having the International Convention date May 13, 1924.

Decarbonizing Iron, etc.

IN a process, invented by P. J. Martin and G. F. Bertels, of Antwerp, Belgium, for decarbonising iron or other metals containing carbon such as chromium, molybdenum, uranium and vanadium by carbon dioxide, oxides of tin, zinc, or iron may be present during the heat treatment to convert the carbon monoxide formed into carbon dioxide. Silica, alumina or lime or other inert materials may also be present. See Patent Application No. 234,434, having the International Convention date, May 23, 1924.

Metallurgical Furnaces

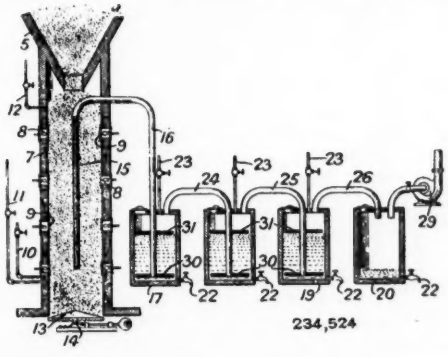
IN a metallurgical furnace invented by B. Talbot, of Middlesbrough, it is not necessary to tap the metal into a separate ladle. The furnace has at each end of the hearth, but separate from it, a bath for molten metal heated by waste gases from the furnace hearth. The deoxidisers, such as ferro-manganese, spiegel, silicon, are melted in the bath by the waste gases before the metal is poured from the furnace into the bath. See Patent No. 235,346, dated April 24, 1924.

Smelting Oxidised Copper Compounds

A PROCESS for the preparation of wet pulverulent metalliferous material such as oxidised copper compounds has been patented by J. C. Hoal and Metals Production Ltd., of London. The material is directly mixed with a liquid combustible material such as tar, so that the particles become coated with the tar and are readily separated from water. It is preferable first to drain or decant the raw material to a thick pulp before treating with tar. In the case of precipitated copper oxide, the water content can be reduced from 30–40 per cent. after draining to 10–15 per cent. after treating with tar. The material is then introduced directly into a smelting furnace and a product practically identical with "set" or "dry" copper as usually produced is obtained. About 10 per cent. of wood tar has been found to be a suitable binding medium. The product of the smelting operation still contains a considerable amount of combined oxygen and may then be subjected to "poling" while still molten to obtain refined metallic copper. See Patent No. 235,641, dated March 19, 1924.

Treating Ores

A PATENT application for a plant for treating ores has been made by D. C. Hare, of Denver, U.S.A. The ore is fed from a hopper 5 into a furnace having walls 7 capable of allowing the passage of air through them to burn the sulphur content of the ore. A porous pipe 15 conveys volatilised metalliferous material to the first of a series of tanks 17 . . . . 20 containing water or other treating liquid. Perforated baffle discs 30, and floating discs 31 are provided in each tank. Gases such



as chlorine can be introduced through pipes 10, 11, and steam through pipe 12. Part of the metalliferous content of the ore may be volatilised as chloride or sulphate and recovered in the tanks 17 . . . 20, and part may be recovered from the residue, which is continuously discharged and then leached. Calcium chloride and catalysts such as manganese dioxide, vanadic acid, or cerium nitrate can be added to the charge, which may also be subjected to ultra-violet rays from lamps 8. Lead, zinc, copper, silver, and gold ores can be treated in this plant. See Patent Application 234,524, having the International Convention date, May 26, 1924.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

FURNACES.—Fuels and furnaces for heat treating. W. Trinks. *Trans. Amer. Soc. Steel Treating*, July, 1925, pp. 58-83. Discusses the relative advantages of each class of fuel as well as of electrical energy and describes the various methods of heat transfer and recuperation in connection with different types of furnaces.

Throat stoppers for metallurgical shaft furnaces. Dr. Münker. *Metall u. Erz*, June (2), 1925, pp. 285-290 (in German). A description of the latest construction of a double stopper for water-jacketed furnaces.

Combustion of coke at the tuyere level of the blast furnace. S. P. Kinney. *Blast Furnace and Steel Plant*, June, 1925, pp. 243-247.

IRON AND STEEL.—Conservation of scrap iron and steel. G. E. Eddins. *Blast Furnace and Steel Plant*, July, 1925, pp. 295-297. Includes some tables showing the growing importance of scrap.

The character of high-speed tool steels. E. Maurer and G. Schilling. *Stahl u. Eisen*, July 9, 1925, pp. 1152-1169 (in German). A physical, microscopic, and thermal comparison with carbon steels.

The practice and purpose of Perlit iron. H. J. Young. *Metal Ind. (Lond.)*, July 3, 1925, pp. 10-12 and p. 14. Shows how the characteristics of a high-quality iron are obtained in the Lanz process.

ALUMINIUM.—The behaviour of non-homogeneous aluminium castings on cold rolling. E. Seidl and E. Schiebold. *Z. Metallkunde*, July, 1925, pp. 221-226 (in German).

TIN.—The effect of impurities on the properties of tin. P. G. J. Gueterbock and G. N. Nicklin. *J.S.C.I.*, July 17, 1925, pp. 370-374T.

ZINC.—The theoretical basis of the metallurgical production of zinc. E. Jänecke. *Metall u. Erz*, July (1), 1925, pp. 316-321 (in German). A discussion of the equilibrium in the system Zn-C-O.

A new hot process for zinc coating wire. J. L. Schueler. *Brass World*, June, 1925, pp. 210-213. A description of the galvannealing method.

CORROSION.—The behaviour of iron and brass in salt solutions at ordinary temperature and at the temperatures and pressures prevailing in steam boilers. O. Bauer. *Stahl u. Eisen*, July 9, 1925, pp. 1101-1109 (in German).

Rust resistance of plated articles by heavier deposits of nickel. E. M. Baker. *Brass World*, May, 1925, pp. 161-163.

ELECTRO-DEPOSITION.—Studies on electro-plating. Part VI. Barrel-plating. W. E. Hughes. *Metal Ind. (Lond.)*, July 24, 1925, pp. 71-73. Discusses the advantages and disadvantages together with some of the principal features of plating barrels.

ANALYSIS.—The analytical chemistry of tungsten steel. F. Fettweis. *Stahl u. Eisen*, July 9, 1925, pp. 1109-1110 (in German).

The estimation of tin in non-ferrous alloys. H. N. Marr. *Metal Ind. (Lond.)*, July 24, 1925, pp. 77-78. An application of the Beringer method.

A new method for the separation and determination of tin in alloys. B. S. Evans. *Analyst*, July, 1925, pp. 330-334.

Quantitative analysis of tin-containing alloys, particularly of white metals. H. Biltz. *Z. anal. Chem.*, No. 7, 1925, pp. 257-272 (in German).

Italy's Reparation Imports

ACCORDING to official figures, Italy's reparation imports for 1924 included the following items (in metric tons): Sulphate of ammonia, 14,884; oil of tar, 2,793; coal tar, 2,093; nitrate of sodium (raw), 1,461; nitrate of ammonia (impure), 1,413. In quintals: Sugar, 32,041; cellulose, 5,838; scientific instruments, 733; inorganic chemical products, 717; synthetic perfumery, 494; organic chemical products, 492; explosives, 308.

Commercial Intelli

The following are taken from printed reports, b... responsible for any errors that may oc...

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered June 26, transfer of £4,000 mortgage and further charge for £1,500, to J. J. H. Weld-Blundell, Ince Blundell-Hall, Blundell Sands, and another; charged on Plas Maenan Estate, Maenan. *£1,002,040. October 22, 1924.

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered July 3, £250,000 B debentures and £500,000 C debentures (filed under section 93 (3) of the Companies (Consolidation) Act 1908), present issues £197,600 and £350,000; general charge (subject respectively to 1st debentures and 1st and B debentures). *£1,002,040. October 22, 1924.

BRITISH STEEL CORPORATION, LTD., London, E.C.—Registered June 18, £300,000 debentures, to Baldwins, Ltd., Baldwin House, Great Trinity Lane, E.C.; charged on properties at Llansamlet, etc., and 5,970 £10 shares in Briton Ferry Works, Ltd., also general charge. *Nil. October 1, 1924.

DICKINSON, GOOD AND CO., LTD., Great Grimsby, ironfounders.—Registered July 13, £5,000 debentures, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge.

FRODINGHAM IRON AND STEEL CO., LTD.—Registered June 20. £149,900 A debs. (2nd series) (secured by supplemental Trust Deed dated June 9, 1925, and ranking *pari passu* with original A debentures, the rate of interest on which is increased); charged on property comprised in original deed and 12,020 £1 shares fully paid in Appleby Iron Co., Ltd. *£680,000. November 8, 1924.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered July 2, £3,000 and further advances not ex. in all £10,764, £2,450 and further advances not ex. in all £8,622 mortgages, to Rotherham R.D.C.; charged on properties at Laughton-en-le-Morthen and Treeton. *£2,410,898 debentures and £243,998 6s. 9d. mortgage. November 3, 1924.

Satisfactions

BOLCKOW VAUGHAN AND CO., LTD., Middlesbrough, ironmasters.—Satisfaction registered June 26, £6,139 16s., balance of amount registered September 9, 1924.

KENRICK (ARCHIBALD) AND SONS, LTD., West Bromwich, ironfounders.—Satisfaction registered July 13, £4,320, registered August 21, 1915.

Pressure Gauges

THE railway centenary has prompted Smith Brothers, of Nottingham, to produce a new booklet on pressure gauges. The firm claims to be the first manufacturers of pressure gauges, and reproduces a tribute to their original invention from George Stephenson, the railway pioneer.

The past apart, however, the modern gauges produced by this firm are all calibrated to a column of mercury and they are fixed independent of the cases by securing the internal workings to a block plate. The works are thus protected from inaccuracies resultant upon heat and strain. The dials are made of heat resisting material and will not discolour. Markings are especially plain for reading in inaccessible positions.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Metallurgy and the Chemistry of the Solid State*

By Professor C. H. Desch, D.Sc., Ph.D., F.R.S.

THERE are many reasons why the chemical study of solids should receive greater attention. In metallurgy, although metals and alloys may, and most frequently do, pass through a molten stage in the course of their manufacture, they may undergo many important changes of structure and constitution at temperatures far below that at which the last liquid portions have completely solidified, and these changes may be so far-reaching as to convert an alloy into one seemingly of an entirely different class, although the gross chemical composition has not altered. Sintering is not always due to the presence of small quantities of molten material between the solid particles, and it is now certain that union of solid masses under pressure may occur without actual melting. This was shown by Spring forty years ago, but for long, although frequently quoted, his results received little consideration. The most striking application of the principle is seen in the metallurgy of tungsten. This metal was formerly described as very hard and brittle, and it is not possible, by casting it and then annealing, to bring it to a ductile form. The method now adopted is to prepare it in the form of a pure powder, and then to bring it to a compact state by compressing, heating, and hammering while very hot, and finally drawing. As this process is continued, and as an originally thick rod becomes extended into a slender wire, the brittleness progressively disappears, and at last the tungsten is obtained in those beautiful filaments, drawn to extreme fineness, with which we are familiar in our electric light bulbs and wireless valves. Even several of the common metals, when their powders are compressed under suitable conditions at temperatures far below their melting points, are capable of forming compact masses with a mechanical strength of the same order as that of the cast metal. The conditions of these reactions, which have been studied by Sauerwald, suggest interesting questions for consideration. A somewhat similar, but perhaps more difficult, problem is that of the adhesion of an electrolytically deposited metal to its support, which is sometimes so perfect as to approach the breaking strength of one of the metals although interpenetration of crystals is not to be seen under the microscope.

Crystalline Structure

There is another aspect of the chemistry of solids which will make an appeal to some who are not chemists, but amateur students of Nature. The great beauty of natural crystals has attracted the attention of poets and artists as well as men of science. Much of this beauty depends on the varying habit of one and the same crystal species. Why should there be this variation, when the chemical composition of the distinct varieties may be identical, so far as analysis is able to give information? According to Curie, the appearance of a given face on a growing crystal depends on the ratio of its surface energy to that of other possible faces, but it has been found that such differences of surface energy as occur are much too small to account for the effect. The work of Johnsen and of Gross has shown that the appearance of a face on a crystal placed in a supersaturated solution is really determined by the velocity of growth in a direction normal to that face, those faces being produced which have a minimum velocity of growth. The presence of impurities undoubtedly has an influence on the velocity, although the effect of very small quantities of impurities has been little studied. Some light is thrown on the subject by a study of the growth of a crystal when solvent is completely excluded, the substance used being sublimed in a vacuum. This has been undertaken by Volmer, who finds that cadmium, zinc and mercury crystals grow in this way in a high vacuum. When small nuclei are present, those grow which have the face with the smallest velocity of growth perpendicular to the stream of impinging molecules. The differences between different faces are large, so that under these conditions either flat tables or long prisms are usually formed, according to the direction of the original nucleus. The crystal grows by the addition of thin laminæ, probably only one molecule thick, which spread over the surface. This is likely to be the process when the crystal is growing in a solution or in a molten mass, as well as in the vapour; and, in fact, when cadmium or tin is being deposited electrolytically at a cathode, or when lead iodide is being formed from a solution of a lead salt and an iodide, the growth of the crystal may be watched under the microscope, when a thin film begins to form at some point on a face, and extends over the face, maintaining a uniform thickness throughout.

Effect of Impurities

Marcellin found that mica might be cleaved by Wood's method of pressure against fused selenium, until the laminæ had a thickness of one molecule. Moreover, there are indications that when molecules strike the surface of such a fresh crystal they first attach themselves irregularly in what is now called an adsorbed layer, before the film takes up regular orientation. It is realised that in the presence of a foreign substance either molecules or ions may attach themselves to such a surface by their residual affinity, and this will necessarily affect the addition of further layers of the original substance. In other words, the velocity of crystallisation in a direction normal to that face will be changed. As the residual affinity of different faces of a crystal must, from the ordinary conception of an atomic space lattice, be different, the habit of the crystal, that is the relative development of different faces, will be altered by the presence of a foreign substance. There is, in fact, evidence that dyes are not equally adsorbed by different faces of the same crystal, so that the state of things just imagined must exist. It is on these lines that an explanation of differences of habit must be sought.

This possible effect of very minute quantities of impurities reminds us that we know exceedingly little of the properties of pure solids. Gases and liquids, which we commonly assume to be easily obtained in a pure state, have been shown, especially by Baker, to alter greatly in properties when deprived of their last traces of moisture, and this is true to some extent even of solids. An illustration may be taken from the effect of dissolved gases on metals. Most metals as cast contain very considerable quantities of gases, either in true solution or trapped during freezing by the growth of neighbouring crystals, and these gases are not removed completely in the later operations of forging or rolling. The effect of gases on the physical properties of the metal has been little studied, but that it may be great is shown by the instance of soft iron used for transformer cores. Either commercially pure iron or the alloy of iron with silicon which is commonly used for this purpose is enormously improved in its magnetic properties by melting in a high vacuum and extracting the dissolved gases as completely as possible. The hysteresis loss is reduced to a quarter or less of its original value by this treatment. Pure iron so freed from gases is almost as soft as copper. The magnetic properties seem to be more profoundly altered than any others, but there is evidently a wide field here for investigation.

* Abstracted from Professor Desch's address, as President of the Chemistry Section, to the British Association at Southampton on August 31.

Impurities other than gases may exert an influence out of all proportion to their quantity if concentrated in the boundaries between the crystal grains. When the added element is insoluble, or practically so, in the metal, the effect is obvious, as in the famous instance of gold to which 0·01 per cent. of bismuth has been added, the soft and ductile gold becoming excessively brittle, as shown by Roberts-Austen as a lecture experiment. Even when the two metals are miscible in the solid state it is quite possible that there may be a concentration of the impurity at the boundaries, if the addition be one which lowers the surface tension of the metal, it having been shown that surface tension plays an important part in the determination of those boundaries. Even if we imagine a metal so carefully purified that all these possibilities have been eliminated, it still does not follow that the mass is chemically homogeneous. There must be some change in the condition of the space lattice as the boundary is approached, and whether we suppose that this disturbance is limited to a layer a few atoms thick, or assume, as Brillouin and Rosenhain have done, that there exists an amorphous intercrystalline layer of appreciable thickness, one must conclude that there will be some chemical difference at the boundaries, and this is confirmed by the effect of etching reagents, which commonly indicate a difference in the rate of etching between the mass of a crystal grain and its boundary.

Lastly, another cause of want of homogeneity in solids is the presence of portions which have been deformed beyond their elastic limit. Such deformation alters the electrolytic potential of a metal, so that a couple is set up between the deformed and undeformed portions, even bringing about action in otherwise remarkably inactive iron of high purity used by Lambert in his experiments on corrosion. A true theory of corrosion will have to account for the formation of etching figures in apparently homogeneous substances.

Single Crystal Specimens

It is now possible, when pursuing the study of solids, to eliminate one of the disturbing factors, the intercrystalline boundary, by making experiments with specimens composed of a single crystal. There are several ways of preparing single metallic crystals of such a size as to allow of the determination of their physical and mechanical properties. Carpenter and Elam have strained sheets of pure aluminium in tension, producing a small permanent elongation, and this sheet, after suitable annealing, shows such a remarkable increase of size of its crystal grains that frequently one occupies the whole specimen. Czochralski's method is to dip a silica point into slightly undercooled molten metal, and then to raise it by clockwork at a rate which just keeps pace with the growth of the crystal, thus obtaining a thin cylindrical specimen. Davey has prepared large single crystals of copper by allowing the molten metal contained in a tube to freeze slowly from one end, whilst tungsten filaments of great length have been prepared by suitable thermal treatment during and after drawing. All these specimens have been studied, their great ductility being a characteristic feature. Even so brittle a metal as zinc has an extraordinary ductility in single crystals. The mechanism of deformation has been examined in detail by means of *X*-rays, aluminium having been studied by Taylor and Elam, zinc and tin by Polanyi and his colleagues, and tungsten by Goucher. There is now a large body of evidence as to the directions of slip in a crystal during deformation, and this knowledge is essential to any understanding of the nature of cohesion, with which the chemical properties are no doubt closely connected.

Alloy Steels

It is the addition of foreign metals which has brought about the most remarkable changes in the properties of steels, out of which there has grown a new and important industry—that of the alloy steels. The presence of foreign elements in the original solid solution has a powerful influence on the rate of change in the system. As a general rule, the change from one lattice to another and the passage of a constituent, such as carbide, out of or into solution are greatly retarded by the presence of alloying elements, a striking example being that of Hadfield's manganese steel, containing about 12 per cent. of the added metal, the effect of which is to delay the change to such an extent that with fairly rapid cooling the solid solution is perfectly preserved so that the steel is relatively soft, its chief peculiarity lying in the fact that any deformation brings about a partial change, producing the hard martensitic structure wherever there is flow. This is the reason for the extraordinary resistance of the alloy to abrasion, and for other properties which, being mechanical, lie outside the scope of the present discussion. Only a comparatively s all number of metals will produce useful alloy steels. Those metals include, first, the immediate neighbours of iron, in the periodic classification, namely, cobalt and nickel, which resemble it so closely in most of their properties, and next chromium, molybdenum, tungsten, and manganese. Copper has only a very limited value as a constituent of steel, and its related elements are apparently of no use for this purpose. Uranium, the heaviest metal of the chromium group, does not alloy readily with iron, and the claims which have been made for its beneficial influence have not been confirmed. A small group of non-metals, all near neighbours of carbon, can enter into the composition of steels, namely boron, silicon, nitrogen and phosphorus, all of which have their uses in this connection. Between the two groups lies the metal vanadium, which is very valuable when added in small quantities to steels.

By varying the composition of alloy steels, and subjecting them to different thermal treatments, a wide range of properties may be obtained, and the number of possible components being so large, it is clear that a very extensive field is offered for investigation. As a rule, only those alloys which lie within certain limits of composition have practical value, but dogmatism on this point is undesirable, and new and unexpected properties may be discovered in a series of alloys when carefully investigated—witness the remarkable discovery of Permalloy, containing 78·5 per cent. of nickel, the remainder being iron, the extraordinarily high magnetic permeability of which in low fields was quite unforeseen and has proved of the utmost value to the manufacturer of cables.

Solid Solutions

Of metallic alloys other than steel, the number of possible combinations is so large that only a minute fraction has been investigated. So far there is no rule by which we can mark out, in the neighbourhood of each metal in the periodic classification, a region within which useful alloying constituents may be found, but it is probable that further work will indicate such a possibility. The modification in the properties of a metal brought about by alloying depends largely on the formation of solid solutions, and when these vary in concentration with change of temperature, that is, when one or other constituent partly separates from solution on lowering, or sometimes on raising, the temperature, there is a possibility of changing the properties of the alloy by suitable thermal treatment. To a large extent this possibility has been neglected in respect of non-ferrous alloys, but experience with the light alloys of aluminium has shown how important such effects may be. Duralumin, which is composed of aluminium alloyed with copper and magnesium, was first found to vary in mechanical properties when its thermal treatment was altered, and its behaviour, which is shared by some other alloys of aluminium, has been explained on the basis of observations made chiefly at the National Physical Laboratory and at the U.S. Bureau of Standards. It appears that certain of the constituents of these alloys, especially magnesium silicide, Mg_2Si, and the compound $CuAl_2$, are more soluble in the solid metal at high temperatures than at low, and that their state of aggregation in the cold alloy depends on the rate of cooling. When first separated from solution, these compounds are dispersed in a condition of ultramicroscopic fineness, but when sufficient time is allowed, diffusion enables them to form larger and larger particles, there being a certain degree of dispersion which is associated with the best mechanical properties. In light alloys, as in steel, the degree of dispersion of one of the solid phases throughout another plays a great part in determining the properties of the composite mass. In this respect alloys resemble colloidal systems, and analogies may be found between the two, but nothing is gained by representing metallography as a branch of the chemistry of colloids.

Metallography

Metallographic structure is essentially a matter of the distribution of solid phases in a system, and the scale of subdivision of one of the phases, although of immense practical importance, is not a factor which alters the fundamental character of the relation between components and phases.

The theoretical part of metallography by means of which we interpret the thermal and microscopical observations of the laboratory is based on the doctrine of phases of Willard Gibbs. The purely thermo-dynamical treatment is, however, too abstract, and it is the simple temperature-concentration diagram which is invariably used to represent equilibria in alloys, igneous rocks, or such artificial mixtures as cements. The equilibrium diagram serves as a guide, even to metastable systems, if the diagram be used to indicate the phases which may be expected to appear when under-cooling occurs, and due use is made of the knowledge of undercooling which we owe to Miers and to Tammann. This is a most interesting branch of metallography, the theory of which is in course of development.

In this review of a large field it has been my intention to show how much remains to be done before we can understand the chemical relations of solids as we do those of liquids and gases. One department of research is, however, more advanced than might have been supposed from my brief references to it, that is the study of the internal changes in metallic alloys as revealed by the microscope and by thermal and electrical methods. Metallography has made wonderful progress since the days of Sorby, and it would repay students of physical chemistry to give some attention to its main results, even though they may not intend to make a special study of the subject. Nowhere are the benefits of the doctrine of phases of Willard Gibbs to be more clearly traced, whilst the recognition of every change of phase by microscopical examination, making use of a technique which has been brought to a high state of perfection, gives concrete reality to the study by direct verification of its conclusions. To understand more thoroughly the mechanism of these changes in alloys we need a fuller knowledge of the relation between crystal structure and chemical behaviour.

Lead Refining in Southern Australia

The Largest Smeltery in the British Empire

THE Broken Hill Associated Smelters Company's works in South Australia, at Port Pirie, 126 miles north-north-west from Adelaide, are the subject of a recent article in *Industrial Australian and Mining Standard*. The principal industry is the smelting and refining of the lead ores from the well-known Broken Hill mining district, situated inland, and distant 253 miles from Port Pirie, to which it is connected by a 3 ft. 6 in. gauge railway. It is also the shipping port for the same group of mines and for an extensive farming district, the aggregate tonnages of coal, coke, timber, and other mining requisites inwards, together with the ore, metal, and wheat outwards, making Port Pirie one of the most important ports in the Commonwealth. The smelting and refining plants were originally erected in 1889 by the Broken Hill Pty. Co., Ltd., for the treatment of the ores from the company's Broken Hill mines, and later a zinc-distillation plant was added to deal with zinc concentrates. The works were taken over in June, 1915, by the Associated Co., and since then the plant has been extended and reconstructed, until now it is the largest and most complete lead smeltery within the British Empire. The zinc distillation plant was shut down in 1921, and has since been dismantled, the zinc from the Broken Hill ores now being recovered electrolytically at the Electrolytic Zinc Co.'s works at Risdon, in Tasmania. A large proportion of the zinc concentrates are, however, submitted to a preliminary roasting treatment at Port Pirie before shipment to Tasmania, the sulphur gases being utilised in the manufacture of sulphuric acid.

At the present scale of operations, approximately 255,000 tons of lead-bearing material are smelted yearly for an average weekly production of 2,331 tons of lead and 136,654 oz. (or 4·18 tons) of silver. Of the tonnage treated 85 per cent. is from the Broken Hill mines, 4 per cent. represents ore purchased from outside properties, mostly situated in Tasmania and the eastern part of New South Wales, and the balance consists of residues from the Electrolytic Zinc Co.'s works, which, after the extraction of the zinc, are returned to Port Pirie for the recovery of the lead and silver contents. In addition to the smelting operations, about 65,000 tons per year of zinc slimes and concentrates from Broken Hill are desulphurised, and the calcines shipped to the zinc works at Risdon, Tasmania, for further treatment. As an adjunct to the zinc roasting section, a contact sulphuric-acid plant is operated, which supplies commercial acid to some of the South Australian manufacturers of superphosphates. The consumption of fuel for power and furnace purposes aggregates 150,000 tons per year. The employees, exclusive of the various branches of the staff, number over 1,300.

The treatment of the lead ores covers three distinct processes, viz., blast roasting and sintering in preparation for smelting, smelting the sintered material in blast furnaces, and refining the furnace bullion to convert the valuable products into marketable form. These products are chiefly silver and ordinary market lead, but the production also includes special brands of lead, litharge, gold, copper matte, and sulphuric acid. The greater proportion of the silver is made up into bars of 1,000 oz., and sold for export to China and other Eastern markets, where, owing to its fineness, it commands a higher price than ordinary standard silver. The market lead is sold in ingots known as English, Japan, and China bars, the two former weighing 112 lb. each, and the latter 200 lb., while the special brands are designated by particular markings. The ordinary lead is refined to a high standard of purity containing 99·988 per cent. of lead, and can be utilised for many purposes for which special brands are generally required. The higher grades of lead manufactured include "sugar-refined," assaying 99·998 per cent. of lead, used for the construction of chemical plant and for cathodes in electrolytic work; and "corroding," made specially for the manufacture of white lead. The antimonial metal contains 88·13 per cent. lead and 11·66 per cent. antimony, and is used in the manufacture of anti-friction, type, and stereotype metals, as well as other alloys whose composition requires lead and antimony. The litharge produced consists of three classes: "industrial," for use in the rubber industry; "flake," for the pottery, glazing, and enamel trades; and "assay," which is guaranteed to contain not more than 5 gr. of silver per ton and to be free from gold.

The blast roasting and sintering plant is made up of three sections, and the charge for the blast roasting includes the following constituents: granular lead concentrates (products from jigs and Whilfley tables); slime lead concentrates (products from flotation units); silicious lead ore; lime sand (from Wardang Island); Risdon residues; granulated slag. In pre-roasting, the sulphur content of the original charge is reduced to about 8 per cent., and in the final roasting to around 2·1 per cent. The blast furnace section consists of five large and two small blast furnaces. The large furnaces measure 23 ft. 3 in. from the bottom of the crucible to the feed floor, and the crucible is 17 ft. 2 in. long by 4 ft. wide by 2 ft. 3 in. deep. The small furnaces are equal in height to the large, but of a lesser area, the inside dimensions of the crucibles being 9 ft. 4 in. long by 3 ft. 6 in. wide and 5 ft. 4 in. long by 3 ft. 6 in. wide respectively.

From the ordinary charge the products are base bullion, which is sent to the refinery, and waste slag. When working on copper dross the products are copper matte, which is sold for refining, and waste slag. The other small furnace (5 ft. 4 in. by 3 ft. 6 in. crucible) is run intermittently for the treatment of antimony slags from the lead refinery.

Formerly ironstone from Iron Knob was used as a flux in the treatment of the lead ores, but as a result of prolonged experiments it was found possible to delete it from the charge. Return slag for fluxing purposes is now quarried from a section of the slag dumped during the earlier smelting campaigns. A wide face ranging from 20 ft. to 25 ft. deep is being operated to produce 200 tons per day.

The refinery comprises eight sets of refining units, three large and five small, each set including one copper softening furnace, one antimony softening furnace, two desilverising kettles, one refining furnace, and one market kettle. The charge capacity of the large sets is 50 tons, and of the smaller sets 37 tons, and the refining method in use is the well-known Parkes process. The furnaces are of the reverberatory type, and those used for antimony softening and refining are water-jacketed. The zincing kettles are cast-iron vessels, hemispherical in section.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Liquefaction versus Carbonisation

THE blast furnace—and to a lesser degree the foundry—depends almost wholly on the provision of suitable qualities of coke for its successful operation. Beehive coke, made in the old-fashioned, wasteful way, was certainly the best material procurable, and even to this day the prejudices in its favour, not, it may be believed, wholly unfounded, linger as a tradition in the iron trade. For many years patent coke, as it was called, made in by-product recovery ovens, was regarded with suspicion, but it has now won its way in popular esteem. The temperatures employed in most coke oven plants are relatively high. Of recent years much has been heard, said and written concerning low temperature coking. The term is not very well defined and is somewhat loosely applied, but may be taken, for general purposes, to mean coking at a temperature of 700° C. or under. The temperature may, indeed, be as low as 350° C. More and better by-products are, it is claimed, obtained by such methods, but it seems well established that, however excellent the residual coke may be for many purposes, it is not what modern blast furnace practice actually requires to obtain the best results. There may be elements of prejudice still remaining, but as yet the case for low temperature coke has not been made out to the satisfaction of most blast furnace managers. The question, from a coal economy point of view, has recently been further complicated by the introduction of methods of liquefying coal, at medium temperatures, and under high pressures, in contact with hydrogen. Such processes leave no residual at all, or an insignificant amount of bituminous matter at most. Obviously, the iron trade can reap no direct benefit from such a process. Indirectly, however, it is possible to conceive that iron ores might still be smelted without coke, and by means of the oil products of coal liquefaction.

Oil-fired Blast Furnaces

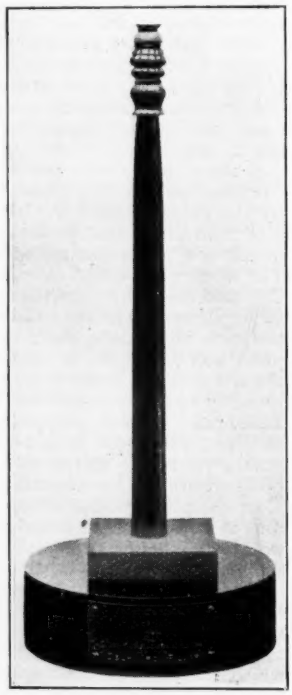
LET it be assumed that processes for the liquefaction of coal become accomplished commercial facts; that the product is, in terms of fuel economy—the crying need of the day—the most economical that can be adopted to secure every potential ounce of value out of a ton of coal, and that it can be obtained economically. It is obvious that in such circumstances, which are apparently within measurable distance of accomplishment, the demand would be that all coal suitable for treatment by such a process should be so treated. At present the limit is said to be coal containing less than 85 per cent. of carbon. It would be more profitable to treat such coal by a liquefaction process than in any other way. A dearth of coke would set in, and the blast furnace, which is not only a plant for making iron, but, in its capacity of a gas producer, an important source of power as well, would either have to adapt itself to the use of the new fuel, or go out of business owing to the coke famine that would result. This seems a revolutionary proposition, but is probably not as revolutionary as it looks. Already, in these columns, particulars have been published as to the use of petroleum residues in blast furnace practice in Roumania. Details have not been forthcoming, or have been meagre, but there is no intrinsic impossibility in smelting iron ore with liquid fuels, sprayed in circumstances which would allow of their decomposition products taking their due and natural part in the chemical reactions necessary to reduce iron from its ores. These things are at present within the realms of speculation, but, whatever the prospects of liquefied coal as a commercial success, it would be well to begin considering the means to be adopted to modify the blast furnace so that it can use the new fuels.

The Bergius Process

IN the meanwhile exaggerated accounts of the Bergius process have been appearing in the daily papers, discounted somewhat by the declaration of the eminent fuel expert, Dr. Fischer, to the effect that the process can have no practical influence on the immediate prospects of the coal industry. Moreover, the process is not new. It was described some years ago by Dr. Bergius himself at a meeting of the British Association in Edinburgh, and the British patents go back to the year 1912. Whatever may be the case now, the original process was exceedingly dangerous, and special precautions of a complicated nature had to be observed. The coal was exposed, in thick walled vessels, to the action of hydrogen at temperatures round about 400° C. and at pressures of as much as 250 atmospheres. Berthelot, in 1869, was the first to hydrogenate coal; he employed for the purpose hydriodic acid, and appears to have met with considerable success. In Sir John Cadman's comparatively recent experiments, pressures of 100 atmospheres were employed and hydrogen used. The ultimate product was a mobile liquid resembling crude petroleum. Allowing for the exaggeration of recent reports, it is evident that the liquefaction of coal will, before many years, become an industrial proposition.

The Iron Pillar of Delhi

AMONG the chemical wonders of the world is the famous Iron Pillar of Delhi, which was erected about A.D. 300, and a facsimile model of this, together with some chippings from the original pillar, was among the exhibits shown by Sir Robert Hadfield at a recent meeting of the Royal Society. The model is about one-twenty-fourth full size and is seen in the adjoining photograph. It is appropriately constructed in non-corrodible steel, since one of the features of the Delhi pillar is the resistance it has offered to atmospheric corrosion extending over a period of sixteen centuries. The immunity of this pillar is probably due to favourable climatic conditions, for, as it is of wrought iron, if it had been exposed to the atmosphere of the sea coast it is probable that very little of it would have been left at the present day. The pillar, which weighs about six tons and is over 23 ft. high, with a base diameter of 1¼ ft., presents one of the conundrums of metallurgical science. As there were no steam hammers or suitable forging presses at the time of its erection, the question as to how so wonderful an object could have been produced remains unanswered.



Manganese Steel

OTHER specimens exhibited at this meeting demonstrated the deformation of the Hadfield manganese steel, specimens strained by tension and compression being shown, in which deformation had caused an increase in hardness from about 180 to no less than 512 in the case of the former method of straining, and 555 Brinell ball number for the latter. The Brinell hardness of Swedish charcoal is 94 and specially treated electrolytic iron about 70. This quality of the "deformation hardness" of manganese steel is possessed by no other metal to such a high degree, and is the property which accounts for its unusual resistance to wear, and which also explains why it is so difficult to be machined. Specimens of manganese steel and nickel steel showed the alloys in both magnetic and non-magnetic conditions in the same bar. In the case of the former, for practical purposes,

it is quite non-magnetic, but by special heat treatment it can be rendered magnetic. In the case of the latter it is rendered magnetic by exposure to a temperature below zero Centigrade by immersion in liquid air. Exhibits of iron-nickel-chromium alloys demonstrated their non-scaling qualities compared with mild steel. These alloys are resistant to scaling at temperatures up to 1,000° C. even in oxidising flames, and accompanying diagrams illustrated the tensile properties and resistance to "creep" under sustained stress at high temperatures from 500° C. to 950° C. A remarkable mirror polished sheet was also on view, the peculiar properties of these steels enabling them to retain the reflective power of a high polish at elevated temperatures.

Magnetic Properties of Alloys

X-RAY spectrograms of silicon steel and pure iron were also shown, the examination carried out by Professor K. Honda indicating that the crystalline structure of silicon steel is undistinguishable from that of pure iron. In addition, the lattice constant is of closely the same dimensions, namely, 2·860 Angstrom units for the silicon steel as compared with 2·864 for the specimen of pure iron. It is evident, therefore, that the remarkable magnetic properties of silicon steel are not the result of any special crystalline formation, but afford a still further demonstration, if this were required, that magnetic properties reside in the individual atoms. In the case of silicon steel it is not yet clear in what way the presence of silicon atoms is able to modify so advantageously the magnetic properties of the iron atoms.

Definition of Steel

STEEL has always been difficult to define, or perhaps it would be more correct to say that it defies definition. Indeed, what is meant by steel has varied more than once in the history of the metal. A recent sub-committee of the erstwhile International Association for the testing of materials sought to fix the definition in terms of the mode of manufacture. Thus, a material produced initially as a fluid mass, and so cast as to be malleable within certain ranges of temperature is regarded as being steel, according to this definition. Long ago, the definition of steel as a ferrous material containing carbon, and capable of hardening on being quenched from a high temperature, broke down. The International Association's definition is now challenged, and quite rightly so, by Professor Sauveur. He instances *Armco* iron, which is made in fluid masses, and is thus, according to the Association, steel. As it is nearly pure iron, it is obvious that to call it steel is a misnomer; its inventors, the American Rolling Mill Co., from the initials of whose name it derives its own, have called it iron, and iron—as Professor Sauveur says—it is. He propounds the following definitions:—

1. *Commercial iron.*—Commercial iron consists of the element iron in a form as pure as can be obtained commercially.

2. *Ingot iron.*—Ingot iron is commercial iron produced in a liquid form and cast.

3. *Wrought iron.*—Wrought iron is a malleable ferrous metal produced in a pasty state.

4. *Steel.*—Steel is a malleable alloy of iron and carbon usually containing appreciable amounts of manganese.

It is all very unsatisfactory, but appears to offer a perennial field for the inventive genius of certain metallurgists. Professor Sauveur's definitions would exclude mild steels with low carbon, and all carbon-free tool steel alloys. It leaves electrolytic iron unplaced; it certainly is not "commercial iron," and yet it is "in a form as pure as can be obtained commercially. The temptation to define the indefinable is as strong as that of measuring the fathomless. It is one that should be resisted.

Canada's Non-Ferrous Metal Production

IN 1924 there were 340 concerns, representing a total capital investment of $116,526,157, engaged in manufacturing non-ferrous metal products in Canada, according to a compilation made by the Dominion Bureau of Statistics at Ottawa. Raw materials costing $44,457,475 were converted into manufactured articles with a total selling value of $95,754,162; this was the largest output since 1920 and a substantial increase of 7·5 million dollars over that of 1923. Increased production was reported in all but the brass and copper products industry and in the miscellaneous non-ferrous metal group. The aluminium industry showed a slight improvement, and the lead, tin, and zinc products industry recovered and showed a selling increase of a million dollars over the previous year. Imports to Canada for the non-ferrous metal trade declined from $43,432,617 in 1923 to $41,660,085 for 1924; of this total $34,081,128 or 81·8 per cent. came from the United States and only $4,029,750 or less than 10 per cent. from Great Britain. Exports during the same years rose from $65,911,171 to $84,780,015, and $14,992,464 or 17·7 per cent. went to Great Britain.

The Mining, Metallurgical, and Chemical Branch of the Dominion Bureau of Statistics at Ottawa states that the 819 plants in Canada engaged in the manufacture of non-metallic mineral products had a combined output valued at $112,572,837 in 1924 as compared with $113,453,012 in the preceding year; this figure includes clay products worth $1,824,523 from plants using imported clay as a raw material and which was not included previous to this year.

Water Power for Aluminium Plant

FOLLOWING the recent announcement by the Premier, Mr. Taschereau, of Quebec, that a huge power development coupled with the erection of a large aluminium plant would soon be under way on the Saguenay River, it is now definitely reported that the proposed project is one of the greatest industrial developments ever planned for Canada, involving the expenditure of practically $100,000,000, including the power development at the falls "Chute a Charon" on the Saguenay and the erection of the aluminium plant. The Aluminium Co. of America, together with the Duke interests of New York and the well-known Price concern of Quebec, are the financial sources behind the huge project. The first of these is already established in Canada through its subsidiary, the Northern Aluminium Co. at Shawinigan Falls, Quebec, and there is no doubt but that Quebec's wonderful water power advantages outweighed all other locations as to the site for the huge works. It is estimated that the new works will consume from 600,000 to 750,000 horse power. Bauxite, transported by a fleet of fifteen ships from British Guiana, will be the chief raw material. Preliminary work in connection with the site is already under way, and the stimulus given to Canadian engineering companies, electrical manufacturing establishments, and cement, steel and iron industries is already being noticed.

Possible Uses of Tantalum

IT is only recently that it has been possible to produce tantalum in a state of high purity and capable of being worked mechanically, and the history of this metal is the subject of an interesting publication just issued by the Smithsonian Institution, Washington. As early as 1824 Berzelius first obtained tantalum in the metallic form, and in 1903 it was produced in Germany in a state of sufficient purity for use as drawn filament wire for incandescent lamps, but was then replaced for this purpose by tungsten.

In considering the possible uses for this metal, its high melting point, its resistance to chemical corrosion, its tendency to absorb all the common gases, and its relatively low temperature of oxidation have to be taken into account. Tantalum seems to be a suitable metal for the manufacture of certain dental instruments, as it is not attacked by any of the antiseptics or chemicals used and can be readily sterilised by heat. A surface film of hard material about as hard as agate can be produced on the metal by proper heat treatment. It will probably soon be found possible to harden the material throughout, thus combining all the advantages of tempered steel with absolute chemical inertness. It has been suggested for use in the manufacture of pens and analytical weights. Its use in chemical containers, parts of pumps, and other equipment will depend upon the cost at which the metal can ultimately be produced. Tantalum is suitable for cathodes in electro-chemical analysis, and in some respects is more suitable than platinum. For instance, zinc may be plated directly upon the tantalum, as it does not alloy with the metal, while gold or platinum can be deposited upon the metal, as they can be removed by aqua regia without attacking the electrode.

Undoubtedly tantalum in the form of sheet, wire, or ribbon will find application in the manufacture of wireless sending and receiving tubes, and it also has interesting possibilities on account of its property of acting as an electrolytic valve.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

After all, the threatened trouble with the miners did not materialise, and once again industry has a breathing space. Whether the means used to avert the strike were wise or foolish it is difficult to decide, although the subject has been pretty well threshed out in the Press. One thing certain is that the conflict has only been postponed, and that at the end of the nine months' truce we shall have a crisis quite as acute, if not more so, unless in the meantime some plan can be formed whereby the miners will receive a reasonable wage and the owners will be able to sell their coal at a price which is on the right side of the cost. We should like to use the word "earn" instead of "receive" in connection with the wages, but we are afraid it is a hopeless task to get the point of view indicated by that word accepted by the men. Yet the solution of the problem is largely there. Better wages can be paid if they are really earned, and when that condition of things is restored we shall see much of the distress not only in the coal trade but in the iron and steel trade, disappear.

A good deal will depend on the finding of the Commission that is being appointed. If it is unfavourable to the owners, the men's leaders will get further encouragement added to that which they have received from the recent settlement. If it is against the men, that in itself will not induce them to abandon their threatening attitude, but it will enlist the public sympathy more on the side of the owners, and that will be a considerable factor in deciding the ultimate issue. The men are evidently making great preparations through their Federation for the coming struggle, and one assumes that the Government are also making all the necessary preparations to deal with whatever emergency may arise. Beyond that we must wait and see.

The Subsidy

The actual fact with which we are faced at the moment is the subsidy. Various estimates have been given of the total cost of this, from ten to forty million pounds. Whatever it is, the burden will be added to the load which surely was heavy enough before, and addition to taxes rather than relief from them seems to be indicated. It is rather galling to the iron and steel manufacturers to know that, after five years of unexampled depression and difficulties, they are still left to find their own way out of an almost hopeless situation, whilst the coal trade, after not more than one bad year, preceded by exceptionally good years, is to receive assistance from the nation at large, and that they will have to contribute largely to this financial assistance. What a case could be made out by the steel trade for a subsidy, in comparison with the coal trade! The steel workers are not in a position to hold the country up to ransom like the miners, and one doubts very much whether they would do it if they could. They have suffered very patiently for a long time conditions of hardship, more so than any other industry, but, speaking generally, they have not rebelled against the established machinery of negotiation, and apart from sectional troubles the industry as a whole has been quiet. One wonders what effect the granting of the subsidy to the coal trade will have on them.

The temporary calm which has been brought about by the Government's decision has not had any effect on the steel trade. There is no improvement to report in conditions this month. The small spurt in buying which was caused by the prospect of a stoppage of the collieries subsided as soon as the decision was known. The old feeling of apathy came back, and on the top of this was the holiday spirit. In Lancashire particularly August Bank Holiday is the commencement of a series of holidays which have a marked effect on trade. Orders are held over until the works reopen, and there is no hurry then. Many of the steel works take advantage of this season to close down for holidays and repairs; and altogether it is a quiet month. In the course of a week or two we may expect to see the usual autumnal improvement in trade, although even a normal condition would appear an improvement in comparison with the holiday month.

Slightly More Optimistic

If anything the tone is slightly more optimistic, and this feeling will probably be translated into improved trade in the closing quarter of the year, as is generally the case. At present there is very little doing, and prices are still moving downwards. The justification for reductions is as much or as little as it has been for some time. Costs hardly warrant them, and certainly there is no increased business as a result of them. There were some who thought that the coal subsidy might mean cheaper coal, but that is hardly likely; indeed, there may be an attempt to stiffen prices a little. Scrap seems to have reached the lowest level. The dealers who have any to sell are not too keen to dispose of it at the present offers, and the least increase in the demand for it will have the immediate effect of increasing the price.

The work on the new cruisers will shortly be commenced, and this will be of some little assistance to the steel trade. The first two are to be built at Portsmouth and Devonport dockyards, and the following two early in next year will be built at private yards. These orders will be eagerly awaited. Some hopes have been aroused, too, by the visit of the Russian delegation, and one hears of substantial orders being placed. Meantime, the number of unemployed continues to rise, although this is not surprising at this time.

Pig Iron a Weak Market

Pig iron has been a very weak market recently. Prices have fallen all round by about 2s. 6d. per ton, and some surprisingly low special offers are being made. Particularly is this the case where makers have large stocks which they are anxious to turn into money. There is some little demand for foundry iron, especially for the light castings trade, but the heavy foundries are doing very little, and forge iron is hardly wanted at all. Basic iron is also very quiet, and when an inquiry comes into the market the prices which are offered in competition are quite unremunerative. The blast furnace position is rather curious. The number of furnaces working is comparatively small, and many of these are faced with the alternatives of putting iron into stock or reducing output. Yet, when the time comes for any real quickening of the steel trade and the works get busy, we shall probably have to contend with a considerable shortage in pig iron supplies. So many furnaces have been put out of action that it is doubtful whether there are sufficient left to cope with a full demand from the steel works.

The finished iron trade is still struggling along, with an outlook far from bright. Orders do not increase, and although there is not so much buying of continental material, this is offset by the larger quantity of steel bars being used by the nut and bolt makers.

The Steel Trade

The steel trade is no more fortunate than the other sections. The demand is poor and prices are low. Sections and ordinary plates remain at about the same level as last month, with the same heavy cutting for substantial orders. The boiler plate price has been reduced 20s. per ton. There has for some time been a feeling that the margin between the price of ordinary plates and that of boiler plates has been much too great, and even this 20s. reduction leaves the price about £3 per ton above ship plates. The prices of steel bars are falling, and for the small sizes the market is still dominated by the re-rollers, who are using either continental billets or English seconds. It is only the steels for special purposes that can command a good price, and the trade in these qualities continues fairly good. English billets have fallen well below £7; in fact, £6 10s. is a common price, but even that is 15s. to 20s. above continental prices. There is not a great deal of buying of foreign steel at the moment. The Belgian strike has interfered somewhat with deliveries.

July Statistics

The output figures for July are not very good. The production of pig iron amounted to 492,700 tons, as compared with 510,300 tons in the previous month. Steel is a little better, being 590,400 tons, compared with 585,400 tons in June, but June was a holiday month, and when this is taken into account the July figures are disappointing. The output of steel for the same month last year was 100,000 tons more; and the

pig iron output was 120,000 tons more. It is not pleasant news that 12 blast furnaces were stopped during July, four being blown out and eight damped down.

The imports and exports for that month also are not encouraging. It is true that the imports of iron and steel and manufactures thereof are slightly down, but they stand at nearly two million pounds, which is nearly £800,000 more than in 1923. For the seven months ending July the total imports of this class of goods are nearly one and a half million pounds more than the previous year, and 6½ million pounds more than 1923. Exports for July are over 5½ million pounds, nearly one million less than in 1924. For the seven months the total exports are 5¾ millions less than 1924.

At the same time France is showing record export figures, the June total being the highest yet reached, namely, 318,800 tons as compared with our 275,700 tons.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Extracting Metals

IN a process for reducing ores, particularly iron ore, in a rotary furnace, the ore is mixed with coal and flux, and is heated by the combustion of powdered coal. The fineness of the coal and the proportion of air are so adjusted that two combustion zones are produced. In the first zone the coal burns to form carbon dioxide, and in the second zone this is converted into carbon monoxide by the excess of coal. The ore is first fed to the second zone where it is reduced, and then to the first zone where it is melted. See Patent Application 234,853 by L. P. Basset, of Paris, having the International Convention date, June 2, 1924.

Another process for extracting metals relates to those which form volatile compounds with sulphur, such as tin, molybdenum, and bismuth. The ore is heated to 800°–900° C. and sulphur vapour, hydrogen sulphide, or carbon bisulphide is passed over it. The gas is diluted with steam, nitrogen, carbon dioxide, carbon monoxide, or combustion gases to prevent the reduction of iron compounds, and to expel the tin sulphide. The tin sulphide may be electrolysed or otherwise reduced to obtain the tin. See Patent Application 234,157 (Guggenheim Bros., New York), having the International Convention date, June 7, 1924.

A process for reducing ores by the reducing action of silicon has been patented by W. B. Hamilton, of Manchester, and F. Reid, of Norfolk, Va., U.S.A. In an example, iron is melted in an electric furnace lined with magnesite, and a reception slag consisting of lime and fluorspar, and sand, is then formed on the top of the iron. Chromite is dissolved in the slag, and carbon is then added in small quantities. The carbon reduces the sand, setting free silicon, which then reduces the chromite and is oxidised again. The whole of the chromite is reduced in this manner by adding successive quantities of carbon, and descends into the molten metal below the slag. Further charges of chromite and carbon may be added. See Patent No. 236,739, dated July 29, 1924.

Purifying Antimonial Lead Alloys

A PROCESS for removing arsenic from antimonial lead alloys has been patented by United States Smelting, Refining and Mining Co., of Portland, Me., U.S.A. The molten alloy is heated to 480°–540° C., and caustic soda added in the proportion of three parts to each part of arsenic present. Air is blown through to agitate the metal, and the arsenic compound formed is removed from the surface. The treatment is repeated until the arsenic has been removed to the required extent. The antimony in the alloy is not affected. The removal of the molten dross floating on the metal is facilitated by adding a thickening material such as cement, crushed firebrick, crushed lead blast furnace slag, ground fireclay, or sand, when the thick mass may be readily scraped or skimmed off. If the alloy contains copper as an impurity, this may be removed before the arsenic by treating the alloy at a temperature of 295°–315° C. with sulphur in the proportion of one part of sulphur to each part of copper. The copper forms a dross on the surface and is removed. See Patent No. 236,782, dated October 16, 1924.

Desulphurisation of Sulphide Iron Ores

ACCORDING to a process patented by W. S. Millar, of London, a sulphide ore of iron such as iron pyrites or pyrrhotite is treated with sulphur dioxide in a muffle furnace, the lower floors of which are kept at a temperature below 950° C. The sulphur dioxide may be obtained by burning sulphur or pyrites. Part of the sulphur is first expelled from the ore, leaving it with the composition FeS, and in the lower hotter parts of the furnace this is converted in Fe_3O_4. The magnetic oxide thus obtained is concentrated and briquetted. The desulphurisation can be accelerated by the regulated admission of steam with the sulphur dioxide. The gases containing sulphur pass into condensing chambers. See Patent No. 236,256, dated March 7, 1924.

Encouraging Research

Sir John Dewrance's Scholarship Suggestion

SIR JOHN DEWRANCE, vice-president, delivered the fourth autumn lecture to the Institute of Metals in Glasgow on Tuesday. His subject was "Education, Research, and Standardisation," and after surveying past research and inventions, he said that there were now twenty-four research associations covering most of the principal industries. Many had their own laboratories and conducted their own research work, while others did so in part and commissioned other laboratories to carry out researches for them. The system adopted by the Department of Scientific and Industrial Research had the great advantage of bringing before the directors of the industrial concerns the necessity for research and discovery through the administration of the Association of their own industry. He referred also to the work of the National Physical Laboratory, the Royal Society, and like organisations. Speaking of past research, invention, and discovery in various industries, Sir John said that he doubted whether, with all our progress, we could make stained glass to equal mediæval products, probably because those makers had a cheaper supply of wood for fuel.

Scholarships in Research

Outlining facilities for research, the speaker said that the twenty-four research associations offered considerable opportunity for young research workers, and if these associations could do so, it would be a splendid thing to give joint courses in research and would enable these research students to start with the facilities necessary. Such courses would fit them for further appointments or independent work. History showed that discoverers were born and not made, but they needed an adequate education, and scholarships in research would bring the best men to the front, to the benefit of science and industry.

There was much, he said, still to be discovered. We had discovered nitrogen fixation, but not the form of nitrogen that our crops preferred. We had still to learn the control of the microbes of the earth, and better use should be made of sewage.

Standardisation was intimately connected with research, and Sir John referred to the work of the British Engineering Standards Association and the need for international standardisation.

In conclusion, the speaker said that very gradually, and perhaps carefully, this nation was raising the status of the discoverer and research worker, but there were still many such workers who were insufficiently rewarded for their labours and successes.

Indian Steel Bounties

THE Indian Tariff Board's report regarding the grant of supplementary protection for the Indian steel industry has been issued, and recommends payments during the eighteen months from October 1, 1925, to March 31, 1927, subject to a maximum of 90 lakhs of rupees, as a bounty to firms manufacturing, mainly from pig iron, steel ingots suitable for rolling or forging into any of the kinds of steel articles. The bounty, it is recommended, should be at the rate of 18 rupees per ton on 70 per cent. of the total weight of the ingots manufactured each month.

The Board observes that the increase in Customs revenue is likely to exceed the bounty payments by 24 lakhs of rupees in the three years which the Steel Protection Act remains in force. It does not propose an increase in the Customs duties on rolled steel.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALUMINIUM.—Testing for porosity in aluminium castings. R. J. Anderson. *Metal Ind.* (*Lond.*), August 14, 1925, pp. 145-146. A number of methods of testing castings and a method and apparatus for comparing porosities of different alloys are described.

COPPER.—Arsenic and nickel and their oxygen compounds in copper and their effect upon the mechanical properties of the latter. J. Ruhrmann. *Metal u. Erz*, July (2), 1925, pp. 339-348 (in German). An account of a detailed research into the forms in which the arsenic and nickel are present.

IRON AND STEEL.—The mechanism of the reduction of iron oxide in gas currents. II. K. Hofmann. *Z. ang. Chem.*, August 20, 1925, pp. 715-721 (in German). An experimental investigation on the reduction of iron oxides by hydrogen.

Oxygen in iron. P. Oberhoffer. *Stahl u. Eisen*, August 6, 1925, pp. 1341-1348, August 13, 1925, pp. 1379-1384 (in German). The effect of oxygen on the properties of iron and the *rôle* of the said oxygen in steel manufacture are discussed.

Some alloy steels for automobile construction. C. H. S. Tupholme. *Metallurgist*, July 31, 1925, pp. 98-101. The composition, properties and uses of a large number of chrome, nickel, chrome-nickel, chrome-vanadium and chrome-molybdenum steels are described.

Some common defects in large forgings. J. F. Harper. *Blast Furnace and Steel Plant*, July, 1925, pp. 278-281. An explanation of the cause of such defects and the methods of ensuring homogeneity of the material.

Fundamental principles of corrosion. G. M. Enos. *J. Ind. Eng. Chem.*, August, 1925, pp. 793-797. Corrosion explained in terms of the electronic theory. The corrosion rates of a series of steels at different temperatures have been investigated.

NICKEL.—The chemistry of the Hybinette nickel-refining process. F. E. Lathe. *J.S.C.I.*, August 21, 1925, pp. 433-438T.

FURNACES.—The development of the recuperator. E. R. Posnack. *Blast Furnace and Steel Plant*, August, 1925, pp. 327-329. A review of the history and applications of the recuperative furnace.

The treatment of metal residues and scrap. Part I. Whitemetal residues. E. T. Richarz. *Metal Ind.* (*Lond.*), August 21, 1925, pp. 161-164. Discussion of the design, building, and firing of the melting pots.

ANALYSIS.—The complete analysis of brass. Part I. Estimation of tin, antimony, phosphorus, and sand. *Metal Ind.* (*Lond.*), August 14, 1925, pp. 139-140.

ELECTRO-METALLURGY.—The present state of the electrochemical and electro-metallurgical industries. IV. L. Andrieux. *L'Ind. Chim.*, July, 1925, pp. 303-305 (in French). A review of the history and the statistics of the electrolytic production of sodium, calcium, magnesium, aluminium, and cerium.

CORROSION.—Electrolytic corrosion. Dr. Michalke. *Chem. Apparatur*, July 10, 1925, pp. 121-122; August 10, 1925, pp. 144-146 (in German). An outline of the causes of electrolytic corrosion.

GENERAL.—Metals in the gaseous state. C. H. M. Jenkins. *Metallurgist*, July 31, 1925, pp. 106-109. A summary of the available information on the vapour pressures of metals and alloys.

ALLOYS.—Constancy and structure of some definite series of mixed crystals. F. Saeftel. *Z. Metallkund.* August, 1925, pp. 258-264 (in German). An investigation of the solid solutions of magnesium, aluminium, antimony, tin, zinc, cadmium, and manganese in silver.

Fatigue in non-ferrous alloys. B. P. Haigh. *Bull. Brit. N.-F. Metals Res. Assoc.*, July, 1925, pp. 11-16. The relationship between the fatigue limit and tensile strength, and the effect of sudden changes in cross-section are considered.

The duralumin problem. W. Fraenkel. *Z. angew. Chem.*, August 13, 1925, pp. 696-699 (in German).

The application of X-rays to the study of alloys. H. Weiss. *Roy. Soc. Proc.*, August 1, 1925, pp. 643-654.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W. Registered August 7, £49,200 B debentures part of £250,000; general charge. *£1,002,040. October 22, 1924.

BLAENAVON CO., LTD., ironmasters. Registered August 5, £36,000 1st debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge (excluding locomotives and rolling stock). *£408,764 debenture stock. December 23, 1924.

CARNFORTH HEMATITE IRON CO. (1915), LTD.—Registered August 21, £1,000 mortgage, to E. E. Unsworth, Carnforth, solicitor; charged on property at Pringle Bank, Warton. *£122,800 1st mortgage. £150,000 2nd debentures issued as collateral security. April 3, 1925.

GJERS, MILLS AND CO., LTD., Middlesbrough, ironmasters. Registered July 28, £25,000 debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge. *Nil, October 7, 1924.

KENRICK (ARCHIBALD) AND SONS, LTD., West Bromwich, ironfounders. Registered August 13, £4,350 mortgage, to Ironite Co., Ltd., 11, Old Queen Street, Westminster; charged on property at Spon Lane, Smethwick, with certain reservations, etc. *£19,320. October 8, 1924.

MOND NICKEL CO., LTD., London, S.W.—Registered August 19. Trust deed dated July 31, 1925, securing £1,000,000 debenture stock; charged on properties at Clydach, etc., also general charge (subject to £375,000 5 per cent. 1st mortgage debenture stock and £1,300,000 8 per cent. mortgage debenture stock already issued). *£1,675,000. July 24, 1924.

WIDNES FOUNDRY (1925), LTD. Registered August 4, £37,000 1st debenture, to bank; general charge.

The Nickel Casting Process

THE results of an investigation into the process of nickel casting are given in a technological paper, No. 281, of the Bureau of Standards, published at Washington. It appears that the casting of nickel presented so many difficulties that for a considerable number of years after the discovery and isolation of the metal it was only available in the form of small cubes and grains. Castings of nickel and of its alloys were brittle and could not be rolled or drawn. This foundry brittleness was thought to be due to the presence, within the metal, of nickel oxide, and experiments were made with various deoxidising agents; additions of manganese were tried with some success. Finally, in 1879, T. Fleitmann, a German metallurgist, discovered and patented a process which consisted of adding metallic magnesium in amounts of from 0·05 per cent. to 0·125 per cent. to the molten nickel just prior to casting. This method was completely successful in imparting ductility to the resultant metal and, with only slight modifications, is used at the present time.

So successful was the process, that the mechanism of the reaction was not investigated, and the original brittleness of cast-nickel alloys was still somewhat vaguely explained as being due to the presence of oxides and dissolved gases. That there was something more in the action of the magnesium on the nickel than mere deoxidation and degasification was becoming increasingly apparent, and an investigation was begun in 1921 by the United States Bureau of Standards, with the object of ascertaining, firstly, why cast nickel, when not treated with magnesium, was brittle, and, secondly, what reactions took place upon the addition of magnesium to molten nickel.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

A Survey of the Platinum Metal Industry

By G. Malcolm Dyson, B.Sc., Ph.D.

IN spite of the comparative rarity of platinum and its congeners, these elements seem to have been known since about 1600, when Scalinger, in a treatise on the mysteries of alchemy, made mention of an infusible white metal, insoluble in all the known menstrua, which came from Mexico. There seems no doubt that this metal was platinum, although the first mention of the element by that name occurred in the latter end of the first half of the eighteenth century, when, in a report on the French Astronomical Mission to South America, an account was published of a metal "platina," which was white in colour, but otherwise similar to gold—with which element it was often found allied; indeed, its first use was for the adulteration of gold, for which purpose it was eminently suited by reason of its high density and unalterability.

The study of this new metal was taken up by many experimentalists, among them Scheffer, who first showed that platinum was attacked and dissolved by *aqua regia*, and Margraf, who found that from the solution so obtained the platinum could be precipitated in the form of a compound salt by the addition of solid ammonium chloride. The double salt so obtained—ammonium chloroplatinate—was the basis of the next step in the elucidation of the metallurgy of these elements, since Knight in 1801 showed that on heating it in fireclay moulds the ammonia and chlorine were volatilised and the platinum left in a coherent, spongy mass which could be forged into malleable ingots at a white heat. Wollaston afterwards perfected the method, and described it in the Bakerian Lecture for 1828. He also separated and investigated the chemical properties of some of the other platinum elements, and we owe to him, together with Johnson (and later to George Matthey), much of our knowledge of these elements.

It was, of course, soon recognised by these investigators that crude "platinum" was a mixture of metals, and from the various varieties of the crude material the six elements, platinum, palladium, osmium, iridium, rhodium, and ruthenium, have been separated.

Occurrence and Mining

It is very rarely that platinum occurs in combination with other elements, although the arsenide sperrylite is known, and occurs to a small extent among the nickeliferous ores of Sudbury, Canada. By far the largest part of the commercial platinum is obtained from the native elementary metal, which occurs disseminated as small, round, flattish grains, among certain alluvial deposits, as a consequence of which its extraction is a matter of careful washing.

There are two distinct methods used for the removal of the ore from the "placers." The first applies only to cases where the ore bed is at the bottom of an existing river, and consists in dredging the gravel from the bed, sorting, and passing the partially concentrated gravel to a series of washers, where the platinum is extracted. Oversize and tailings are usually dumped overboard. The labour entailed by this method is small, so that working costs are low, and in many places are gradually superseding more crude hand labour. The disadvantages are that "spares" for the machinery are hard to obtain in some far-away locations, and that the climatic conditions on many deposits (e.g., those of Russia and Siberia) preclude its use during the winter months.

The older, simpler, and more usual process of platinum mining merely consists in removing the overburden and digging out the alluvium with pick and shovel. The sand is then worked up for crude platinum in simple washers—the heavier platinum grains remaining behind, while the lighter particles of siliceous material are washed away. Since hand labour has not to any great extent been superseded by mechanical excavators, the working costs are high, especially as the amount of platinum relative to the gangue is very small. The washed ore is never pure, and contains not only the other platinum metals, together with a small admixture of gangue, but also appreciable percentages of gold, copper, and iron. An assay of an average quality specimen of raw platinum from South America gave :—

	Per cent.
Platinum	81·31
Iron	6·92
Palladium	1·07
Rhodium	2·70
Iridium	0·98
Copper	0·70
Osmium and volatile matter	3·92
Gold	1·27
Sand, etc.	1·13

Ore from Tasmania consists almost wholly of osmiridium, and forms the world's principal supply of this hard alloy.

Metallurgy and Separation

Early on in the history of these metals extraction was performed by a species of cupellation process, but this is now discontinued entirely, and the platinum of commerce is obtained by digesting the crude metal with *aqua regia*, when the majority of the platinum dissolves and can be precipitated as ammonium chloroplatinate by the addition of ammonium chloride. From this spongy platinum is prepared by heating, and then melted into ingots.

A considerable amount of platinum is obtained as a by-product in the refining of other metals. Thus in the case of the nickel and copper ore of Sudbury, mentioned above, the ores are smelted and a crude matte of impure copper sulphide obtained. This is bessemerised, when iron and sulphur are oxidised and slagged off, and a pure matte of copper sulphide obtained. The copper prepared from this by reduction contains both gold and platinum as an impurity, and these are both removed in the process of electrolytic refining. The copper is cast into slabs, which are suspended as the anode in a bath of copper sulphate solution. Slender pure copper plates form the cathode. On the passage of the current the copper alone is dissolved away from the anode and redeposited as pure copper on the cathode, while the impurities fall away from the anode as a "mud" which is caught in a canvas bag. Anode mud is obtained in a similar way from silver and gold refineries. The anode mud from copper contains silver, gold, and platinum, and is melted down and the elements separated by electrolysis in a suitable bath. Any platinum is obtained in the third or "final" anode mud, and is treated with *aqua regia* in the usual way.

For many purposes, both scientific and commercial, pure metals are required, so that a more or less elaborate scheme has been devised for the separation of these elements. Raw "platinum" is found on examination to consist of two kinds of grains, the dull steel grey grains of platinum with 10–20 per cent. of other metals and some bright, hard grains of osmiridium. On treating the mixture with *aqua regia*, the osmiridium remains undissolved, together with any gangue, while the softer platiniferous grains dissolve; so that a partial separation is effected.

Treatment of the osmiridium.—Much of the osmiridium can be used as the alloy, but where separation is required the following process is resorted to. The osmiridium is alloyed with zinc, and gives an alloy that is comparatively easily soluble in *aqua regia*. The solution is distilled in superheated steam, when the osmium comes over as osmic acid, and is either used as such or, in rare cases, converted to the metal. The acid liquor remaining contains ruthenium and iridium, and is treated with ammonium chloride, when after long standing the iridium is precipitated as ammonium chloroiridiate.

Treatment of the platinum liquor.—The platinum liquor obtained by extracting the crude metal with *aqua regia* is treated with ammonium chloride, when ammonium chloroplatinate is immediately precipitated as orange yellow crystals. They are quickly filtered off and the filtrate allowed to stand some time, when any iridium present is precipitated as

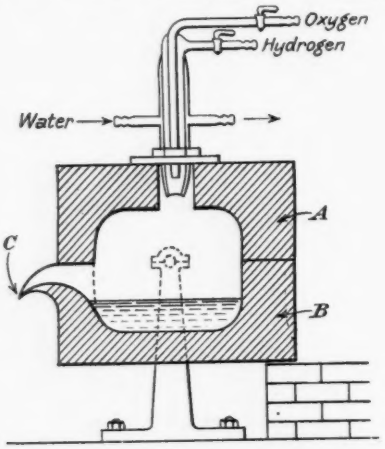


FIG. I.

ammonium chloroiridiate. The ammonium platinichloride is worked up into platinum sponge by roasting, and the ammonium chloroiridiate treated for iridium in the same way. The remaining mother liquor is treated with zinc, when the remaining metals are precipitated as a black mud. This mud, known commercially as "first blacks," is dried, roasted, and extracted with dilute sulphuric acid. This removes, as soluble sulphates, any base metals that may originally have been present. The purified blacks are then treated with dilute *aqua regia*, when palladium alone dissolves, leaving rhodium with a trace of ruthenium. The palladium is precipitated from its solution by the addition of iron, and the rhodium-ruthenium residue fused with barium peroxide, after which the fused mass is treated with *aqua regia*. The two can then be separated by means of the ammonium salts. The metals so obtained are purified by a second treatment.

The Oxy-hydrogen Blowpipe

The metallurgy of these elements is greatly facilitated by the use of the oxy-hydrogen blowpipe for their fusion. The usual type of furnace is shown in Fig. I. The furnace itself made of specially bonded lime and encased in a sheet iron framework, is made in two blocks, A and B, and is supported on trunnions, to facilitate pouring from the spout C. The flame of the oxy-hydrogen blowpipe plays directly on the charge, which is placed in the cavity of the lower block, and considerable quantities of platinum can be melted in a short time. The blowpipe is water cooled, and is often provided with a platinum nipple. Melting in such a furnace also provides a certain amount of purification, since base metal and siliceous impurities form slag immediately absorbed by the furnace walls. On the other hand, the supply of oxygen and hydrogen to the blowpipe has to be very carefully regulated, since platinum will absorb a considerable amount of these gases, to give ingots of metal which retain much of the gas, even on solidification. This gas is apt to reappear as "blisters" during the rolling and annealing of the metal.

In physical properties the platinum metals resemble one another closely, being unalterable in air at the ordinary temperatures and highly refractory. Platinum, palladium, and ruthenium are almost indistinguishable in colour, while osmium is a very bright white metal. On the other hand, iridium and rhodium have a bluish-grey tint and are not so brilliant as the others. Osmium has the highest melting point at about 2,600° C., and its density—23—is higher than that of any other element. With reference to density the elements fall into two groups—the "light" and the "heavy." Thus rhodium, ruthenium, and palladium have densities between 11 and 12, while those of platinum, osmium, and iridium lie between 21 and 23. This is, of course, in accordance with the Atomic Numbers of the elements, and their places in the Periodic System. Further, osmium and ruthenium are easily the hardest of these metals, the latter, after annealing, being about 200 Brinell. Platinum and palladium are the softest of the group, both being about 50 on the Brinell scale, while iridium at 170 and rhodium at 140 must be accounted comparatively hard.

Platinum has a valuable property, which it shares with iron, of softening at some considerable distance below its melting point, so that welding of platinum apparatus is possible. It is not appreciably volatile below 2,000° C., although some of the other elements are not so permanent. Thus palladium is appreciably volatile at 1,200° C., and iridium easily oxidises to a volatile tetroxide at 1,000° C., while osmium will actually burn in air when strongly heated to the tetroxide. Thus the presence of osmium and iridium in laboratory platinum apparatus is a source of loss of weight on prolonged ignition, a phenomenon often noticed with some of the older "platinum" crucibles and dishes.

Uses of the Elements

Platinum.—It is obvious that a metal with the physical properties of platinum will have extended applications in both scientific and industrial problems. Its unalterability in the air has led to its adoption for the manufacture of standard scales and weights, and its chemical inactivity has led to its use in concentration stills for sulphuric acid manufacture, and for much similar chemical plant where ability to stand hot acid is necessary. The fact that it is not oxidised in air even at high temperatures renders it admirably suited to the construction of laboratory ware for the determination of ash, and for analysis of rock materials by fusion, as well

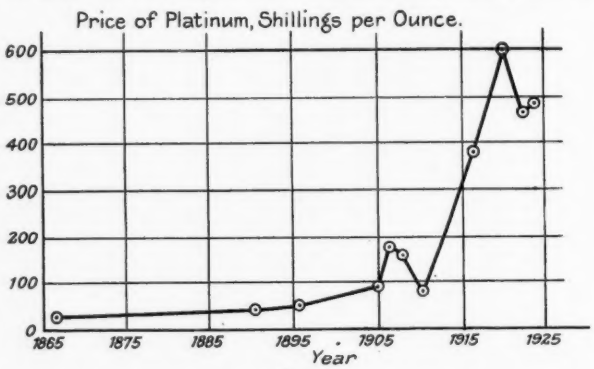


FIG. II.

as for the manufacture of electrical contacts, where "make" and "break" cause sparking which would foul a baser metal —*e.g.*, in relays, etc. The fact that platinum has an expansion co-efficient similar to that of glass enables it to be fused into that material, giving a gas-tight joint, and so facilitates the construction of X-ray tubes and other physico-chemical apparatus. As wire or tape it finds employment in the construction of electric resistance furnaces, and as finer wire in the making of incandescent electric lamps. It also enters into the construction of much physical and surgical apparatus, and its chemical uses are also manifold. Photography employs it in the platinotype—a process which uses a paper sensitised with a mixture of ferric oxalate and potassium platinichloride. This paper, on exposure to light, becomes blackened, the ferric salt being reduced to the ferrous state and the platinic salt to the metal. Images produced in this way have the advantage of great permanence. In the laboratory it is used as a reagent for the estimation of potassium, and also as a catalyst, in which rôle it accelerates many reactions, principal among which is the oxidation of sulphur dioxide to the trioxide. This reaction has been developed in

the many forms of "contact" process for sulphuric acid that are now being worked. The most favoured contact mass is one in which the precious metal is deposited on balls of anhydrous magnesium sulphate. This not only affords a large surface of active material, but enables the platinum to be recovered (when contaminated with catalyst poison) by the simple process of dissolving away the magnesium sulphate, and filtering off the platinum metal, which can then be purified. In the preparation of screens for X-ray work, it is found that the most phosphorescent materials available are the salts magnesium and barium platinocyanides, which consequently find considerable employment in this direction.

It is a cause for regret that much of the world's available platinum is used up in the fabrication of useless jewellery. Each year more than a third of the supply of platinum is used up in this way, and the price is thereby forced up (Fig. II). Its suitability for jewellery work lies in the fact that its

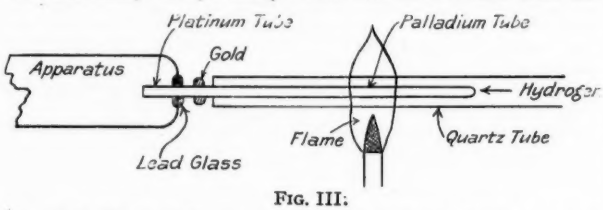


FIG. III.

strength allows of the construction of most slender and graceful designs, without loss of rigidity; while its colour enhances the brilliance of diamonds, for the setting of which it is chiefly utilised.

Palladium.—This element has been used as an adulterant for platinum, but its principal use is in the laboratory, where it is used as a means of introducing very pure hydrogen into vacuous apparatus. The device by which this is accomplished is shown in Fig. III. A short length of platinum tube is sealed by means of a blob of lead glass through the apparatus, and to the platinum, a palladium tube 8 cm. by 0·3 cm. and closed at one end, is soldered by means of a small lump of gold. The whole forms a completely gas-tight system. The introduction of hydrogen is performed by slipping a sleeve of clear fused quartz over the palladium tube, and heating it to a dull redness, while a current of hydrogen passes through the quartz sleeve, and over the palladium. Hot palladium is so rapidly permeable to hydrogen, that by this means a comparatively large apparatus can be filled with hydrogen to a pressure of some centimetres in a few minutes. Since hydrogen alone can pass through the heated palladium, no impurities enter the apparatus.

Osmium.—It has often been reported that osmium is used for the construction of lamp filaments, on account of its extreme infusibility, but this seems doubtful, since a recent inquiry among the dealers revealed the fact that osmium wire could not be procured. On the other hand, osmic acid finds a use in histology for staining nerve cells in microscopic preparations.

There is no commercial demand for pure rhodium and ruthenium, although rhodium chloride is sometimes added to the gold solutions used for producing the gold colour on porcelain, since it enhances the colour.

Alloys of the Platinum Metals

Among the most important alloys of this series is osmiridium, or iridosmine; the latter term being used when the iridium content is in excess of the osmium. This alloy is extremely hard, and is used for tipping fountain-pen nibs, and electrical contact studs. A platiniridium is used in the jewellery trade containing 10 to 20 per cent. of iridium, which gives greater strength to the alloy, while in dental practice a whole series of platinum alloys are used. The first "dental" alloy to be used was one containing two parts of silver to one of platinum, but as the price of platinum rose, so the amount of platinum in these alloys decreased until an alloy with only 5 per cent. platinum was used. Palladium-silver alloys were substituted, but the supply of palladium, being dependent on that of platinum, was soon exhausted. The alloy between platinum (or palladium) and gold is white in colour, and is used, not only as a solder for platinum ware, but also as an alloy for jewellery under the name "white gold." An alloy of platinum with 2 to 3 per cent. of copper is used for making pins for dentures.

The Wet Extraction of Ores

Modern Vat Construction

ALTHOUGH the process for dissolving certain ores in acid liquors is considered simple, there are many points in connection with the construction of the vats which require attention. When the tanks are not accurately built the process requires constant supervision to ensure economical production, so that the extra original cost of really efficient plant is fully compensated for by the good results secured. Originally the operations were conducted in wooden tanks lined with sheet lead of varying thickness and heated internally by steam injected through a perforated lead pipe. The shape of these tanks was usually rectangular, which resulted in accumulation of unattacked ore in the corners. Moreover, the injection of steam did not carry sufficient force to agitate the contents of the vat satisfactorily, so that the rate of dissolving was not maintained at the maximum unless constant stirring was resorted to.

A short description of the construction of one of the modern types of tank will show that the working of many of these may be supervised by one man. Instead of a rectangular tank, the vessel is cylindrical, the bottom portion tapering to a truncated one. The outer shell may be made of old steel boiler plates riveted together, but in the event of leakage the effects of corrosion are severe, and wooden planking is generally preferred. There are now several varieties of tank in use, which are lined with thin sheet lead, the base being lined with pumice or some other type of stone which will resist the action of the acid. This latter preventive is also used with a view to reducing the effects of the steam which is forced in at the bottom, and otherwise would cause a heavy wear on the unprotected sheet lead. Four outlets are usually provided for drawing off the contents of the tank when the desired proportion of mineral has been dissolved, and these are arranged at different depths from each other.

Agitation by Compressed Air

Steam is introduced through a vertical lead pipe attached to flexible steel tubing above, and suspended by a pulley, so that it may be raised or lowered as desired. At the side of the steam pipe another lead pipe of larger diameter is supported by a second pulley and extends almost to the bottom of the tank. This second pipe acts as an agitator, allowing air to be blown through the liquor in the tank, and keeping all solid matter in suspension throughout the operation. Various types of blowers are employed for injecting the air at high pressure, and must be sufficiently strong to maintain constant motion of the contents from start to finish. This action replaces the continual plunging or paddling which was necessary with the older varieties of vats, and incidentally adds oxygen, which is favourable to many chemical reactions. In place of blowers or fans, certain injectors worked by steam can be used with equally good results, but these are usually only applied when the tanks are built of large dimensions. The pulleys from which the two pipes hang are mounted on a bracket, a chain passing over them being counterpoised by a weight on the other side from the tank. This means that the system is kept in equilibrium, and any adjustment can be made without difficulty. The liquor to be used as the solvent is raised to boiling point if the mineral is of an insoluble nature.

Before charging the ore the liquor is raised to a state of thorough agitation, so that the particles are given little opportunity to settle from the commencement. The charging is usually conducted by means of a small elevator, which raises the finely ground ore from a bin in small bucketfuls at a time. Each bucketful is swirled about among the liquor before the succeeding one is emptied, thus promoting rapid solution of all soluble matter. Samples of the rich liquor are drawn periodically until a fixed concentration has been reached. The rich liquor is allowed to settle, and either syphoned or pumped off and fed through a filter, prior to passing on to the precipitating department. Washing off the insoluble residue is greatly facilitated by the constant agitation of the air blast, and can be completed in a very short space of time. Summarised briefly, the advantages gained by using a tank of the foregoing description are (1) the prevention of accumulation of insoluble residue, (2) more intimate contact between the ingredients, (3) more rapid chemical action and more complete extraction, and (4) a considerable saving of labour.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Iron and Steel Institute Meeting

Of the long list of papers presented at the Birmingham meeting of the Iron and Steel Institute that by Mr. Donald Campbell was incontestably the most interesting. It described the applications of the Northrup high-frequency induction furnace to the making of high-grade alloys. The furnace is at present built in small units only, but larger sizes can be supplied as and when demand justifies their manufacture. The author is perfectly frank in regard to certain disadvantages they possess. The plant required to produce high frequency current is difficult to make, and it requires a high degree of metallurgical and engineering skill to attain success in design and construction. The cost, too, is high. On the other hand, there can be little doubt that for experimental and research purposes, and, eventually, for industrial use in the preparation of the highest grade alloys, the furnace possesses ideal characteristics that go far to compensate for the high initial cost. A greater temperature gradient can be obtained in a Northrup furnace than in any other in which metals can be melted in bulk. Moreover, the conditions under which the operations can be carried on; the high temperature (upwards of 2,000° C.); and the fact that the heat is generated within the molten metal, and not transmitted from external walls, enable the materials to attain an unusually high degree of purity. Carbon, so valued a constituent of ordinary "straight" carbon steels, appears to mask, vitiate or destroy some of the best and most valuable properties of many alloy steels, notably the chrome nickel, and nickel-iron groups. In the Northrup furnace it can be completely eliminated, and in the result alloys with the most remarkable properties can be produced.

"Mumetal" Nickel-Steel

One such, to which the name "Mumetal" has been given, displays, to a peculiar extent, the property of magnetic permeability. Such alloys, which are now being made in the larger types of furnaces available, with capacities in the order of 600 lb., have very low hysteresis loss, and their magnetic properties can be controlled so that they range from maximum neutral permeability to maximum permeability at magnetic saturation, or high or low fields for magnetic saturation. The magnetic permeability of an alloy of the following composition is 7,000:—nickel, 74 per cent.; iron, 20 per cent.; copper, 5·3 per cent.; manganese, 0·7 per cent. This alloy affords an instance of the composition of Mumetal, which derives its name from μ, the symbol for magnetic permeability. When used for electric cables, the acceleration at which messages can be sent, owing to this property, is eightfold the rate with ordinary cables. In this direction alone, therefore, the employment of Mumetal may be expected very greatly to reduce costs and thereby benefit the commercial community, while further new uses will, in the future, be found for it and for Permalloy, which has already proved its value.

A New Steel-making Process

Of the other papers presented at the meeting, the contribution by Mr. H. Flodin, purporting to describe a new direct process for the manufacture of steel, proved disappointing, as it contained little information of real importance. It was said said that no difficulty had been experienced in producing iron and steel of any desired carbon percentage by a continuous process in the electric furnace, without the use of the blast furnace. The process could, it was claimed, be controlled quite as easily as manufacture by the open hearth process, and the steel produced was of quality superior to the open hearth and Bessemer products. The raw materials used were Swedish hematite ore, and English coal and Swedish charcoal. In the course of a long discussion on the process, however, it was admitted that iron and steel of great purity had for many years past been produced experimentally by the direct method, but that the system was uncommercial and could not be adapted for ordinary working.

From the standpoint of the British manufacturer, even if the claim made for the commercial possibilities of the new process were substantiated, its adoption would be precluded by the high cost of electric current in Great Britain. The relative prices of electricity in Great Britain and Sweden on the basis of a kilowatt year are £8 and less than £2.

Radiographic Examination of Metals

Although the X-ray examination of iron and steel has already yielded the most valuable information as to the nature of the crystal structure of α, β, γ, and δ-iron, and, at the hands of foreign metallo-physicists such as Westgren and Phragmen, has cleared up the anomalous and vexed question of the nature of β-iron, its practical routine employment in the metallurgical laboratory is yet in its infancy. In the paper trades, in the textile industries, and in such applications as the detection of faulty work in glued wooden structures, aero-parts, etc., X-ray apparatus has found a wide and ever-increasing application, but apart from such uses, and in the laboratory research to which X-ray methods furnish so valuable an adjunct, it may be said that the commercial technology of X-ray work has not as yet extended to the works laboratory or is merely in its infancy in this connection. The reasons are not hard to seek. Very great experience is required in the operators; the technique is difficult, and, finally, iron is a very opaque substance to the passage of the rays, hence a very high voltage is required to get anything like satisfactory results. There are plenty of 60,000 volt appliances about, of good make and value, but these only suffice for very thin sections of metal, and are mainly used for the purposes of other industries. For higher voltages, transformers are apt to be expensive and troublesome to make and handle. At the wonderful department for X-ray research, presided over by Dr. Pullin, perhaps the leading investigator in the country, apparatus employing 400,000 volts is in use, but the accessories are all made in the department itself, where even the glass tubes are blown by workmen specially acquainted with the requirements of the work. With 400,000 volts a penetration of 4 in. or 5 in. of metal becomes easy, and for the detection of flaws such an equipment affords at once shadowgraphs yielding copious information.

Sir William Bragg's Investigations

In the meanwhile those interested in the classical work which finds expression and record in photograms of the Debye, Laue, or Müller-Shearer type may be well advised to turn to the account given by H. Weiss in some recent numbers of the *Revue de Metallurgie*, where they will find a simple and stimulating account of the technique of X-ray photography.

In these articles the crystal and powder methods of Sir William Bragg and Dr. A. Müller are very fully described and the details of present-day practice in the investigation of the atomic structure of metals explained. Due credit is given to Westgren for his work on iron, and further reference made to δ-iron, the modification found to exist at 1,450° C. Of more particular interest is the light which can be thrown by X-ray examination on states of strain in metal. In this connection de Broglie has shown that a number of minute crystals having a common axis of orientation, owing, for example, to the operation of rolling, but differing in their arrangement around that axis, can behave as a single crystal rotating round that axis, and so afford characteristic spectra. The work of Elam and Carpenter, and of Taylor and Müller, has thrown light on hardening, or, rather, strain-hardening phenomena, the maximum effects being produced, apparently, by initial minute deformations upon which grosser subsequent deformation has very much less hardening effect. The Laue photograms of metals show, moreover, that the distinctive markings extend and are displaced further apart radially in proportion as the metal becomes deformed. The process of slip, in crystals, and of ultimate fracture, has received attention, and here again X-ray photograms have been requisitioned to afford further information as to what really takes place. The metallurgical laboratory must, it would appear, wait, for a time, on the physical laboratory. Until technique improves and the cost of high power apparatus cheapens, the iron and steel metallurgist must be content to get much of his information at second-hand. If, however, he feels inclined, during the process of waiting, to read the subject up he might profit-

ably study the interesting literature published in this country by Adam Hilger and Co., who are rapidly popularising the smaller forms of X-ray apparatus.

Developments in Magnesium

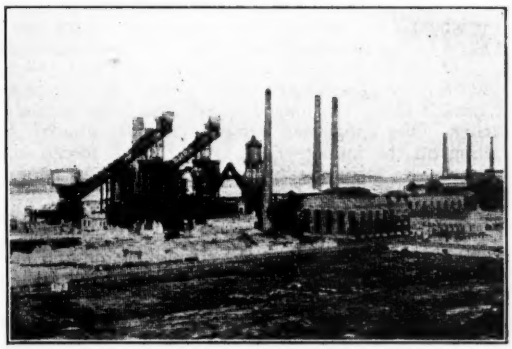
MAGNESIUM is probably distributed almost as widely throughout the world as aluminium, and, like that metal, its potential ore resources are enormous. There are vast deposits of magnesite and of dolomite, which is a magnesian limestone. Magnesium salts, from which the metal can be obtained by electrolysis, are found in close association with the famous Stassfurt deposits of potassium minerals. The chlorides are likewise present in commercial amounts in sea water concentrates and brines. Altogether, there is plenty of magnesium about in a locked-up state. A key has recently been found on the continent to unlock this treasure-house. The phrase is chosen deliberately. At present magnesium is known only as a photo-chemical curiosity, or as a pyrotechnical adjunct. Flash powders and flares are not, however, the only uses to which this most extraordinary metal can be put once supplies are available. It has properties of a paradoxical character, but of a degree of industrial importance which bids fair to put aluminium completely into the shade once it is produced in sufficient bulk to compete with it. At present the world-production is only a matter of a few tons per annum, probably less than 100 tons. At one works alone, abroad, arrangements are in hand for an early prospective production of 80 tons per week. When the properties of the metal, hitherto little known in this country in bulk, are better appreciated, the revolutionary nature of the prospect will be better understood. The literature of magnesium is scanty and much of the information available is incorrect or misleading. It is, for example, described as malleable but not ductile. This is quite a misapprehension; pure magnesium is both. It is hard, but it can be readily machined, and is so tough that screw threads cut in this metal preserve their sharp contours and resist wear far better than aluminium, copper, or, for that matter, brass threads. It is the lightest commercial metal known, being some 60 per cent. the weight of aluminium. It conducts electricity far better than that metal, and its tensile strength is far higher. It is a beautiful metal, and takes a high polish. It does not tarnish to anything like the extent which is supposed. Finally, its ductility *and* malleability are such that it can be rolled, drawn or stamped with the utmost facility.

It exceeds aluminium in these applications. Its heat conductivity is very great, hence it is proving most useful for the manufacture of pistons for aero engines. Indeed, the bulk of the present production goes to the United States, where it is used for this purpose. Altogether, the future prospects of the metal, once increased supplies are forthcoming, are likely to be exceedingly promising, and as it will not cost more than about twice the price of aluminium, and is about half the weight, the two metals may be expected to compete, bulk for bulk, on fairly equal terms and with interesting results.

German Iron Industry

THE proposed amalgamation of five of the largest groups of German steel firms in the Rhenish-Westphalian district, which was recently announced, would have created an indeed formidable combine in the industry, but it now appears that Krupp's have withdrawn from the project. The principal objects of the union were the rationing of output and the sharing out of processes among the groups, but it is explained that the Krupp's organisation is not suited to amalgamation on these lines. Since the war the concern has specialised in certain lines of steel production and refining processes and have always, for instance, concentrated on steel for the construction of motor-cars. The firm is apparently unwilling to surrender these special lines, preferring to work on its own as hitherto, and considers it in the interests of the German heavy industry that the name of Krupp's should not disappear into an amalgamation. But it is understood that the firm has no intention of working against the trust, if it is formed, and, on the contrary, is prepared to co-operate by means of special agreements to fall into line with every effort at rationing that may be made. If it should be considered in the general interests to limit production of any particular articles Krupp's would not, it is stated, remain outside any general arrangement to that end.

It is evident from these arrangements that the German iron industry is finding it necessary to take steps to combat the depression from which, like the British trade, it is suffering, although a recent visit to some steel works at Krefeld on the Rhine did not indicate any marked depression. Iron wire seemed to be the principal product of the foundry, and miles of this were being prepared. The demand in this line is understood to be slack at present in Germany, and the trade is largely working against future orders. As over 10,000 men were being employed at this works, however, for ten hours a day, and bearing in mind the credit limitation policy now being pursued by the banks, it was difficult to see on what resources a concern of this size could continue paying wages at this rate, unless there was quite a considerable demand.



STEEL WORKS AT KREFELD ON RHINE.

While this conclusion is based on a visit to a single iron works, it is not improbable that these conditions of activity apply to the rest of the trade, and certainly an air of steady improvement characterised the several factories in Germany, notably in chemicals and silks, which were visited in the same connection.

Dissociation Phenomena in Producer Gas

SOME very interesting investigations have recently been carried out in France with a view to ascertaining to what extent dissociation takes place in the producer gases traversing the regenerators of an open-hearth furnace. It is only of quite recent years, in the interests of fuel economy, and with the object of investigating the part played by the heat exchanges between the hot gas and the brickwork of the chequers, that attention has been seriously directed to what may be termed the thermal efficiency of the open-hearth furnace. In this connection the work of Siègle has been both thorough and illuminating. The question of dissociation has, however, attracted little notice hitherto, although it is obvious that if it actually occurs at all it must have an important influence on the true heat-balance of a furnace. In one investigation on the subject a series of systematic analyses of the gases showed that their composition varied within not inconsiderable limits, a phenomenon ascribed by some furnace designers to dilution due to the in-leakage of air into the chambers, with the resulting oxidation of some of the carbon monoxide to carbon dioxide. The experiments leave no doubt that dissociation does occur, sometimes to a marked extent, and that its occurrence is very greatly influenced by the presence of oxide dust deposited on the chamber walls and in the crevices of the chequer work. The dust particles play a dual rôle: they have an insulating effect on the hot bricks, which prevents efficient heat exchange, and they favour reactions which lead to dissociation. The latter are not wholly injurious; they may even increase the temperature of the gas. It is the insulating effect that militates against the most efficient practice, and this serves to explain why, at times, when the accumulated dust layers are unduly thick, the performance of an open-hearth furnace drops. At the end of a campaign, what is gained by the hotter temperatures of the gas may be lost by the lower thermo-chemical composition it possesses. The investigations would appear to show that a better performance might be expected in an open-hearth furnace if some method of automatically blowing the dust out of the chequers could be employed intermittently, so that the chequer work walls, no longer coated with a badly conducting deposit, could play their proper part in the heat exchanges, upon the due occurrence of which successful working so greatly depends.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

We have on several occasions called attention to the very serious condition into which the steel trade of this country is descending, and the seriousness of it is beginning to impress itself more and more, not only upon the steel makers, but on the nation as a whole. This is shown by the numerous references which are being made in all sections of the Press, and the movements, private and public, which are afoot to try to bring about some amelioration. Things were bad enough at the beginning of the year, but they are now decidedly worse. In all bad times previously, there has been some hope in the knowledge that the depression must necessarily be of limited duration, and that the lean and prosperous years had a habit of coming round in cycles. But the improvement now is being too long delayed, and hope seems to be departing. One dangerous symptom is the apathy which is settling on the industry. It is as though forces were at work which are too powerful for the industry to cope with. Mills are closed down, furnaces blown out, workmen are discharged, and many trained staff men are without employment. A firm employed directly in the iron and steel trade that can show a profit in these days is something of a wonder. On the other hand, we read day after day of heavy losses, and of preference dividends being passed, while the reserves and accumulated profits which prudent firms have put by for the lean times are being rapidly used up.

Steel Trade Outlook

Well-meaning efforts are being put forward to discover a solution of the problem. Manufacturers are urged to look into their costs and see what can be done to cheapen production, as though that had not already been done. Committees are being formed to consult with each other in order to find a remedy, but we have not much faith in them. The men are exhorted to co-operate with the employers, so that output may be increased and production costs reduced. There again we are not hopeful. Wages have been forced down to a very low level, low enough to make it very doubtful whether any further reductions are possible. Yet an increase in the hours of work is a proposal which will certainly not be agreed to by the men. So we are faced with a languishing industry, workmen employed only part of their time and earning wages which, in many cases, are barely sufficient for proper living, a number of unemployed which is dangerously high, and increasing financial difficulties all round. Truly it is a gloomy picture; and if help is to come it will have to be here soon. Only a day or two ago we heard a prominent commercial leader express the opinion that more than one firm in the iron and steel trade would be compelled to go out of business during the next six months. He may have been pessimistic, but that fate does appear to be the logical end to the conditions now ruling. Lord Invernairn's speech at the annual meeting of William Beardmore and Co. is a plain statement of the position. As he pointed out, orders were taken in 1923 and 1924 at wholly unremunerative prices with the object of keeping works going until more orders at better prices would be obtainable. But that process has had to be repeated, becoming worse at every step. We doubt if there has ever been such a wide margin between selling prices and costs, with the margin on the wrong side. Losses can be incurred for a time, but to continue them indefinitely is bound to end in disaster.

Imports from the Continent

In the meantime, there is a constant stream of iron and steel coming into this country from the Continent, so much so that, as one paper puts it, we are in danger of becoming a mere finishing ground for foreign raw material. That may suit the re-rollers, but it means ruin to the manufacturing side of the industry. It is not to be assumed that the prices at which Continental material is sold here show a profit to the suppliers. These low prices are made possible by the higher prices which are obtainable in the home markets.

Lord Invernairn says that something might be done on the lines of organisation and combination among the steel makers. That has already been done in Germany, where there is not only a system of allocating orders to the works best fitted to execute them economically, but also a scheme is in operation for the restriction of output, so that there shall not be over-production. For September, the members of the Raw Steel Association are limited to a production of 65 per cent. of their capacity. Here every works is striving to keep busy as far as possible to the full extent of capacity, with the result that is now so familiar: prices constantly being cut, and competition carried to lengths which can only be described as mad. Even after all this price cutting and competition, orders are scarcer than ever. With regard to the production figures for August, it is true that holidays interfered with output, but these are the lowest we have had for over two years. They are noticeably worse than they were last August. Steel ingots and castings amounted to 477,100 tons, as compared with 527,500 tons last year, and pig iron was 466,500 tons, compared with 588,900 tons last year.

Prospects for the Autumn

We have now reached the end of September, when it is usual to expect an improvement in the general tone of the market. The holidays are over, and there should be an increase in buying, after the summer quietness. At the beginning of the month, there appeared to be a rather hopeful tone, but this was evidently due to anticipation, and the course of events during the month has not justified it. Orders are still scarce, purchases being, as before, confined to immediate requirements. Prices have all been on the down grade, and, while this may have had a slight effect on the purchases from the continent, it is probable that further reductions in the prices of foreign semi-finished material will be made, and imports will continue. On the whole, it will be well to defer expectations of any improvement in the demand until the spring, particularly in view of the labour unrest.

The coal trade, like the iron and steel trade, is in anything but a happy condition. The export trade is very poor, and the industrial demand is in no sense good. Stocks are accumulating at the collieries, and this makes it possible to obtain spot lots at very cheap prices. The house coal trade will be better when the cold weather comes, but as far as industrial supplies are concerned, the prospects are very discouraging.

The Iron Market

The pig iron market during the month has not changed much, although prices are down a shilling or two. There is very little business doing. Foundry iron is most in demand, but it would be a mistake to assume that there is any liveliness in that section. The ironfounders are taking only what they need to carry them on from day to day. Forge iron is quiet and basic iron is no better. Basic iron is actually being offered at 65s. delivered. Finished iron is in keeping with the rest of the market. It is only for the marked bars and high class engineering material that there is any appreciable demand, and the mills rolling these classes are by no means full. The trade in crown iron bars is stagnant, and the associated works are finding that their price is no use; there is too much underquoting from outside firms. Even with these lower prices, it is impossible to keep the mills really busy.

In the steel market, the two features are the lowness of prices and the scarcity of orders. The official price of sections is now £7 10s., and there is no reason to believe that this is the bottom. That price will be severely tested the first time there is a big order on the market. Steel plates are now down to £8 10s. Most of the papers quote this as an exceptional price and give £8 12s. 6d. to £8 15s. as the official price, but £8 10s. is readily accepted by all the big plate making firms, and much less than this is being quoted by some. The only bright spot is the motor car industry, which continues to provide good orders for steel bars and pressings. Fortunately, there does not seem to be any signs of slackening in this trade, and it is hoped that there will be an even brighter demand after the motor show. The Consett Iron Co. have started part of their plant, including the plate mill. This will mean still further competition among the north east coast makers.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Alloys

AN alloy which resists the action of alkalis has been the subject of a patent application by N. V. Hybinette, of Wilmington, Del., U.S.A. The alloy contains iron with the addition of 18-40 per cent. of nickel and 28-40 per cent. of chromium. Cobalt up to 10 per cent., or copper up to 2 per cent., may be added to soften the alloy. Examples contain chromium 30 per cent., nickel 20 or 35 per cent., carbon 1·5 per cent., silicon 1 per cent., aluminium 0·5 per cent., and manganese 0·5 per cent. See Patent application 236,931 having the International Convention date, July 12, 1924.

Extracting Metals

A PROCESS has been patented by C. Hennes, of Valparaiso, Chile, and of Berlin, for simply and economically obtaining metals from ores and other metallurgical products containing lead or silver. The ore is subjected to the action of an oxidising agent consisting of, or containing, nitrates or nitrogen compounds such as saltpetre to oxidise the lead and silver, and then treating with a saturated solution of an alkali chloride or an alkaline earth metal chloride. If the ore is treated in an oxidising bath, the lixiviation with chloride solution can be simultaneously effected. In this case, the bath may consist of a solution of saltpetre and common salt or calcium chloride. The ore may alternatively be roasted with saltpetre, and then treated with chloride solution. Thus, in treating a lead carbonate containing gold and silver, the ore is first roasted without oxidising means, and lixiviated with common salt. The residue is then treated in a combined bath of saltpetre and common salt, followed if necessary by lixiviation with potassium cyanide to extract the gold fully.

In an example of the treatment of a complex ore containing lead 20 per cent., zinc 30 per cent., sulphur 25 per cent., and silver 0·05 per cent., the ore is roasted with nitrate to oxidise the zinc, lead and silver, and the silver and lead are lixiviated with concentrated common salt solution. The silver is precipitated over copper, and the lead over iron. The zinc is thus enriched by 30-45 per cent., and is worked up further by distillation. It is found that a uniform lye liquid is obtained with only slight losses, so that the process is economical. See Patent No. 237,939, dated March 5, 1924.

Reduction of Copper Ores

A MODIFICATION of processes for reducing oxidised copper ores, previously described in specifications 185,242, 190,246, and 203,383 has now been patented by W. H. Beasley, A. B. Middleton, and Metals Production, Ltd., of London. In the former cases (see THE CHEMICAL AGE, Vol. VII, p. 503; Vol. VIII, p. 67; and Vol. IX, p. 400) the ore was heated in an atmosphere of reducing gases at a temperature too low to melt the copper or frit the gangue, and in the present case, the reducing atmosphere is obtained by vaporising a solid or liquid, *e.g.*, a paraffin hydrocarbon. The substance should be one that will not leave an oily or tarry residue on the ore after reduction, in order that a leaching operation may be subsequently employed. Paraffin oil and naphthalene are mentioned as suitable reducing agents, and in the former case, the oil may be sprayed on to the preheated ore. The reduced ore is then leached with an ammoniacal solvent in presence of air or oxygen. See Patent No. 237,964, dated May 1, 1924.

Reducing Iron Ores

A PROCESS for the production of granular spongy iron by the reduction of finely granulated iron ores has been invented by J. G. Aarts, of Dongen, Holland. The ore is conducted by stirrers or blades against a current of reducing gases enriched with hydrocarbons which on decomposition will cause active carbon to be deposited on the ore. The temperature of the gases is kept below the sintering temperature (800° C.) of the charge. The reducing gases are enriched with hydrocarbons, such as acetylene, in order that a large amount of amorphous carbon may be separated, and the reduction is effected by this carbon and the catalytic activity of the metallic iron. The active carbon is formed only below 600° C., and the added hydrocarbon must be one which decomposes below that temperature, *e.g.*, methane decomposes above 700° C., and is not suitable. The ore is finely divided, and is mixed with the usual additions, and is kept in motion while descending in the furnace. The temperature at the bottom, where spongy iron is discharged, is kept below 800° C., *i.e.*, below the melting or fritting point of the ore. The reduction probably takes place by an intermediate formation of ferric carbide. See Patent No. 238,270, dated April 14, 1924.

Concentration of Ores

IN an apparatus for the gravity concentration of ores, invented by F. H. Cothay, of East Grinstead, Sussex, and Ropp Tin, Ltd., of London, an inclined concentrating sluice is provided with riffles extending across it, and agitators in the form of wires or bands are arranged across the sluice between the riffles, and close to the bottom. These wires are reciprocated along the sluice to prevent compacting of the material without stirring it up. The concentrator is suitable for treating alluvium containing values in the form of tin-stone. See Patent No. 238,297, dated May 14, 1924.

Extraction of Metals

A PROCESS has been patented by A. S. Cachemaille, of London, for reducing oxides which cannot be reduced with hydrogen, *e.g.*, oxides of uranium, zirconium, thorium, vanadium, tantalum, chromium, titanium. In the known methods in which an alkali metal and a halide of another alkali metal or an alkaline earth metal are employed, the reaction is effected in a sealed iron bomb, and it is found that the reduced metal is contaminated by iron. In this invention, the metal oxide is mixed with an alkaline earth metal, and a halide of the same metal, preferably calcium and calcium chloride, and pressed into cakes which are placed in the bomb. The bomb is sealed and the reaction started by heating. The contents are removed after cooling, by means of a star drill which does not touch the iron of the bomb. The contents of the bomb are protected from contamination by iron, by a lining of pure lime. The metal is finally obtained as a fine powder, the fineness of which is determined by the time of heating and the proportions of calcium and calcium chloride. See Patent No. 238,663, dated July 7, 1924.

Metal Production in Russia

Output for the Coming Year

A SUMMARY of the estimated production of the iron and non-ferrous metal trades in Russia for the financial year 1925–26 is given in *Die Metallbörse*. According to the report, the iron industry will produce 2¼ million tons of pig iron, while the probable output of steel will amount to 3 million tons and of rolled iron 2,400,000 tons. The corresponding figures for 1924–25 were 1,200,000 tons, 1,700,000 tons and 1,260,000 tons respectively. The journal points out, however, that the estimated production will not in all probability be reached, owing to the lack of an adequate number of steel cutting and iron rolling works. The number of those engaged in the industry for the coming year will be about 290,000, with an output per man valued at about £175 or 80 per cent. of pre-war production.

Non-Ferrous Estimates

With regard to the production of non-ferrous metals, 13,150 tons of copper will be mined, as against 7,600 in 1924–25, of which over 12,000 tons of coarse copper will be obtained from Ural. The refining will be undertaken at Nischni Kyschtym, and will yield about 9,000 tons of electrolytic copper. As to other metals, the estimates stand at 2,000 tons for zinc, 1,000 tons for lead and 12 tons for silver. The total value of the non-ferrous metals to be produced is estimated at over £7,000,000. The plans for the reconstruction of the Russian non-ferrous industry during the next five years are also reported. In the year 1929–30 it is estimated that nearly 68,000 tons of copper, 19,000 tons of lead and 27,000 tons of zinc will be produced, and the possibilities of the Lena goldfields are stated to be considerable. Several aluminium, nickel and tin works will be erected, as well as lead and zinc works, and the whole project will involve about £12,000,000 of capital.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The properties of some aluminium alloys. H. Hyman. *Metal Ind.* (*Lond.*); Part I, September 4, 1925, pp. 213–215; Part II, September 11, 1925, pp. 238–242. A description of some alloys having good mechanical properties.

Properties and structure of some alloys of aluminium-chromium. F. T. Sisco and M. R. Whitmore. *J. Ind. Eng. Chem.*, September, 1925, pp. 956–958.

Equilibria in the liquid system Fe-Cu-Mn with increasing small carbon content. F. Ostermann. *Z. Metallkunde*, September, 1925, pp. 278–282 (in German).

Constancy and structure of some definite series of mixed crystals. Part II. F. Saeftel and G. Sachs. *Z. Metallkunde*, September, 1925, pp. 294–298 (in German). An investigation of the solid solution of certain metals in silver.

ANALYSIS.—The estimation of oxygen in iron. P. Oberhoffer. *Stahl u. Eisen*, September 10, 1925, pp. 1555–1563 (in German).

The complete analysis of brass. Part II. Lead, bismuth, and separation of copper. *Metal Ind.* (*Lond.*), September 18, 1925, pp. 259–260.

The determination of impurities in commercial tin. H. N. Marr. *Metal Ind.* (*Lond.*), August 28, 1925, pp. 184–185.

Determination of arsenic in steel. A. E. Cameron. *J. Ind. Eng. Chem.*, September, 1925, pp. 965–966.

COPPER.—Some observations on oxygen in copper. F. Johnson. *Metal Ind.* (*Lond.*), September 4, 1925, pp. 205–209.

A consideration of the advantages and disadvantages of "tough pitch" copper as compared with those of "deoxidised" copper.

CORROSION.—The corrosion of certain metals by carbon tetrachloride. F. H. Rhodes and J. T. Carty. *J. Ind. Eng. Chem.*, September, 1925, pp. 909–911.

Scale resistance in the corrosion of aluminium alloys. L. H. Callendar. *Metal Ind.* (*Lond.*), September 18, 1925, pp. 263–264.

ELECTRO-DEPOSITION.—Principles and operating conditions of chromium plating. H. E. Haring. *Chem. Met. Eng.*, August, 1925, pp. 692–694.

The hardness of electro-deposited metals. R. H. Greaves. *Metallurgist*, September 25, 1925, pp. 141–143.

Notes on the plating of chromium on steel. G. M. Enos. *Metal Ind.* (*Lond.*), September 18, 1925, pp. 261–262.

IRON AND STEEL.—The high points in the manufacture and working of steel. L. F. Johnson. *Trans. Amer. Soc. Steel Treating*, September, 1925, pp. 329–339. Outlines the manufacture and mechanical working of steel.

The reactions and effects of nitrogen on steel. C. B. Sawyer. *Trans. Amer. Soc. Steel Treating*, September, 1915, pp. 291–308. Review of literature on this subject and of the author's research.

Vanadium steel. E. Maurer. *Stahl u. Eisen*, September 24, 1925, pp. 1629–1632 (in German). An explanation of the effect of the addition of a small quantity of vanadium to steel.

The use of oxygen and oxygen-enriched air in refining. R. Schenck. *Stahl u. Eisen*, September 17, 1925, pp. 1596–1602 (in German). Relates particularly to iron and steel production.

The manufacture of iron and steel. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*; Part I, August, 1925, pp. 191–240; Part II, September, 1925, pp. 357–373. Illustrated articles dealing respectively with the smelting of iron ore and the mechanical treatment of steel.

The influence of the temperature on the formation of graphite in cast iron. E. Piwowarsky. *Stahl u. Eisen*, August 27, 1925, pp. 1455–1461 (in German).

Stainless or rustless iron correctly described as stable surface iron. P. A. E. Armstrong. *Trans. Amer. Soc. Steel Treating*, August, 1925, pp. 163–189.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BEARDMORE (WILLIAM) AND CO., LTD., London, S.W., steel manufacturers. Registered September 2, £50,000 (not ex.) bond and disposition, etc., to Bank; charged on Parkhead Forge, Glasgow, Temple Motor Works, Anniesland, Dalmuir Shipbuilding and Engineering Works, Dalmuir, Speedwell Ironworks, Coatbridge, and Underwood Works, Paisley; also registered September 2, £50,000 (not ex.) bond and disposition, etc., to Bank; charged on above properties. *£1,581,831 2s. 6d. July 13, 1925.

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd.—Registered September 11, £500 debentures, part of £10,000; general charge. *£3,859. July 24, 1924.

MIDLAND IRON CO., LTD., Rotherham.—Registered September 10, £10,000 2nd debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; charged on company's land at Rotherham, also general charge. *£20,000. July 10, 1925.

Satisfaction

BEARDMORE (WILLIAM) AND CO., LTD., London, S.W., steel manufacturers.—Satisfactions registered September 4, £100,000, part of amount registered July 11, 1924, and March 26, 1925.

Canadian Nickel Industry

THOUGH nickel is not, like iron and copper, one of the world's major industrial metals, it occupies a place of constantly increasing importance, and in so far as Canadian metal production is concerned is second only to gold in the value of the annual output. Canada's nickel industry had its beginning in 1887, in the discovery that certain mineral deposits at Sudbury, in Ontario, that had been taken up and worked for copper also contained nickel and were in reality great nickel deposits rather than copper deposits. Nickel was at this time, however, commercially speaking, a comparatively unknown metal for which there was no great demand—the world's annual consumption being only about 1,000 short tons—so that the history of the first few years of the industry is the record of an almost continuous uphill fight to find new uses and a profitable market for the output. Indeed, competition in the nickel field has always been keen, and though numerous companies have from time to time been formed to engage in the industry in the Sudbury district the only survivors are the two corporations that divide the now great industry between them—the International Nickel Co. and the Mond Nickel Co. At the present time these two concerns account for practically all of Canada's output—in round figures some 35,000 short tons, valued at over $19,000,000, constituting over 80 per cent. of the world's requirements in 1924—except some small amounts recovered as by-products from the treatment of cobalt silver ores. The record production of 46,000 short tons was made in 1918.

Atomic Metal Structure

DR. KARL MUELLER, of the Berlin Physical Research Bureau, claims to have discovered a process by which it is possible to reduce metal foils to a thinness of one 2½ millionth of an inch, while retaining their elasticity. The process can be used with all kinds of metals, including gold, and renders them transparent. The new discovery is regarded as of great importance, and Dr. Mueller has received numerous letters from abroad asking for specimens of metal foils for examination of atomic metal structure.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Magnesium : A Metal with a Future

By L. P. Sidney

WITHIN the last few years a good deal has been published on the subject of light alloys, and with the increasingly rapid progress of aeronautical engineering, for which they are peculiarly suitable, much more attention will doubtless be directed to this useful group of materials. During the war much work was done on the magnesium series of alloys, which combine remarkable and almost unexpected qualities of lightness and strength. Dr. Leslie Aitchison, in particular, has from time to time published valuable particulars respecting these interesting alloys, and engineers and metallurgists are alike indebted to him for particulars which it would otherwise have been difficult for them to obtain. In regard to the publication of particulars respecting magnesium itself, it may be said that the literature relating to that metal is exceedingly scanty. A few writers have hinted at its possibilities, and Dr. Aitchison, in his paper to the Institution of Automobile Engineers, in April, 1924, alluded to the metal in terms which leave no doubt as to his being well aware of its great potentialities. Thus, in speaking of the alloys, he said, "It seems very probable that forged magnesium (in the commercially pure state and without any alloying element) will prove to be as satisfactory as some of its alloys—particularly where any high temperatures have to be faced." Apart, however, from this and one or two similar forecasts of an eminently favourable nature, very little has hitherto been published regarding magnesium.

Relation to Aluminium

Magnesium is a metal belonging to Group II, while aluminium, which in many respects it resembles, is a Group III element. Magnesium is by far the lightest metal produced commercially; its specific gravity is only 1·72 at 15° C., whereas that of aluminium is 2·70; in lightness, therefore, it stands in regard to that metal in the ratio of 100 : 63, and, bulk for bulk, weighs but little over 40 per cent. As cast, its breaking stress is 25 per cent. higher than that of aluminium; in the wrought condition the disparity is much more greatly in favour of the lighter metal. Thus, hard drawn aluminium bar of "substantially pure aluminium" is stated to have, in what may be considered as exceptionally "worked" cases, a tensile strength varying from 28,000 to 35,000 lb. per square inch, which is equivalent to 14 tons per square inch, whereas magnesium of a high degree of purity (99·7 to 99·9), in the form of rolled sheet, has a tensile strength of 20 to 22 tons per square inch, and extruded bars of even higher tensile strength have been made by a special process.

With a strength, therefore, which may with safety be regarded as at least 33 per cent. higher than the strongest aluminium, and a weight of only a little more than half that metal, it is not surprising to find that those who have investigated the possibilities of the pure metal are somewhat enthusiastic as to its future prospects. The following table has been compiled from a variety of sources, and shows the physical properties of pure magnesium as compared with those of copper and aluminium. It should always be borne in mind that unless the fullest details are available as to mode of manufacture, degree of work, etc., tables of this nature exhibit results which are not always strictly comparable in a scientific sense. Much has to be allowed for experimental error of what is sometimes of a subconscious kind, the result of a special predilection on the part of an observer in favour of his particular metal. Even, however, with the due discounting of such factors the results may be regarded as generally comparable.

TABLE OF PHYSICAL PROPERTIES.

	Copper.	Aluminium.	Magnesium.
Atomic Weight	63	27	24
Specific gravity	8·94	2·7	1·72
Melting point	1,082° C.	658° C.	651° C.
*Thermal expansion (Linear: $\times 10^6$)	16	23	25
Thermal conductivity (C.G.S.)	0·95	0·48	0·38
Electrical conductivity (at 20° C.; ohms $\times 10^4$)	57·8	34·5	22·2
Weight of equivalent conductors	1,000	506	500
Tensile strength (tons per sq. in.)			
As cast	10	5·5	7·75
Rolled	16	16	22†
Elongation (rolled)	20 to 30%	3%	2%
Hardness (worked)	25	30	50

* From 0° C. to 100° C. At higher temperatures the expansion of magnesium increases considerably.

† And heat treated.

Properties and Occurrence

Magnesium is a white metal of exceedingly pleasing appearance. Contrary to long established belief, it tarnishes but slowly in ordinary atmospheres, although if zinc be present, corrosion sets in fairly rapidly. The pure metal is, however, practically only corroded in an atmosphere laden with alkaline chlorides, as in sea air. In sea water it disintegrates. Under all normal conditions, it is capable of taking a high degree of polish, and, according to Beilby, the flowed metal at the surface assumes, in these circumstances, an amorphous skin. This has a beautiful, glassy, burnished appearance. Usually, however, the metal is finished with a matt coating, which gives it a thin oxide coating and preserves it from subsequent corrosion. In any case, the deterioration of the metal by ordinary atmospheric agencies is not to be feared; it compares favourably with most of the commercial metals in this respect. Much, too, depends on the degree of purity of the metal itself, as to whether it tarnishes to any appreciable extent, or not. A curious property of magnesium is that it withstands the action of hydrofluoric acid. Flasks and bottles of magnesium are now being employed, instead of gutta-percha, to store the acid in, and have yielded very satisfactory results in practice. Magnesium compounds are abundantly present in the earth's crust. It is estimated that its occurrence entitles it to rank eighth in order of abundance. Magnesium chloride is an invariable constituent of sea water, and the waters of the Dead Sea, in Palestine, contain more magnesium chloride than sodium chloride. The Strassfurt deposits are rich in magnesium chloride, and carnallite is the mineral from which most of the metal at present manufactured is derived.

Process of Manufacture

The electrolysis of fused chlorides is almost invariably the process of manufacture used. Magnesium was formerly made in this country by the British Magnesium Co., Wolverhampton, but this company, although still working the metal, no longer makes it. Some 100 tons or so are now produced annually in France, although in the United States, where, during the war, some 200 tons were being produced annually, the Magnesium Corporation is a subsidiary of the Aluminium Corporation, and the metal is somewhat overshadowed by its older established rival. It is significant

that the production in the United States in 1922, the latest date for which figures are available, had fallen to about 30 tons, whereas the imports were no less than 85 tons. It would appear that, at the moment, Germany has the largest annual production of magnesium, which is made at works at Hemelingen, and Bitterfeld. The world output may be assumed to be in the vicinity of 1,100 to 1,200 tons. It is interesting to note that in the form marketed, with 94 to 96 per cent. of magnesium, the metal is known to users and refiners as " raw material," a technical expression which it is useful to bear in mind.

In order that the most satisfactory results may be forthcoming, the raw material has not only to be refined to a very high grade of purity (99·9 per cent.), but has also to be specially humoured during the subsequent processes of forging and rolling. In the cast condition, it is more or less coarsely crystalline. Rolling can only be carried out within a narrow range of temperatures; if the metal is much over 470° C., it is liable to burn; if below about 425° C., it will crack, and tend to cold-shortness. As the right temperatures are not visual ones, and pyrometric methods are difficult to apply, much skill and care are necessary.

Properties in Fibrous Condition

It has been noted that in the unworked condition, the metal is crystalline. By the Michel process of treatment, independent of ordinary working methods, a French company " Le Magnesium Industriel," at their works at Messières, in Savoy, have succeeded in imparting to the metal a beautiful fibrous structure, which endows it with properties differing greatly from those it possesses in the crystalline condition. One characteristic of the metal in the fibrous condition, is that its heat conductivity is increased threefold. In these circumstances, it practically acts as a self-cooling metal, an advantage which is very great when employed for pistons for aero-engines, to which use these fibrous forms of the metal are being extensively applied, particularly in France. Moreover, its electrical conductivity is far greater in the fibrous condition than in the ordinary crystalline state, a property for which other useful applications are being found.

Use for Castings

Magnesium is well known to be an efficient deoxidiser, and has frequently been employed to ensure sound castings in other metals. With a sufficient head, which, owing to its lightness, has to be generously allowed for, it makes excellently sound castings itself, and has distinct advantages over aluminium in this respect. Moreover, even the best friends of aluminium will not claim that it easily or dependably makes sound castings, although the twice-melting process used at the National Physical Laboratory on a small scale has shown that its habits in these respects can be ameliorated. No one, however, will claim that it can be satisfactorily die-cast. Even Mr. R. J. Anderson, in his *Metallurgy of Aluminium and Aluminium Alloys*, quite frankly says " no actually sound aluminium alloy casting has ever been made," and users of the metal will recognise that this applies to aluminium die-castings as well. Magnesium can not only be die-cast, but die-pressed hot, with results which, in point of workmanship and finish, are unsurpassed and unsurpassable in any other metal. Its machinery properties are, moreover, excellent.

Magnesium is a very wonderful metal, which will rival aluminium not only in its properties, but before long, it may well be believed, in price. At present its cost, weight for weight, is about three times that of aluminium, but, bulk for bulk, less than twice that price, and in view of its strength, its hardness, and its other excellent properties, it may be said already to be competing with aluminium on almost equal terms.

Recent Developments in Flotation Processes

By A. W. Fahrenwald

A detailed survey of the present methods employed in concentrating and classifying ores is given in a publication (Serial No. 2694) recently issued by the U.S. Bureau of Mines. The report, which was prepared by Mr. A. W. Fahrenwald, ore-dressing engineer to the Bureau, is accompanied by a number of interesting flow-sheets, two of which we reproduce in conjunction with the author's more important conclusions concerning flotation systems.

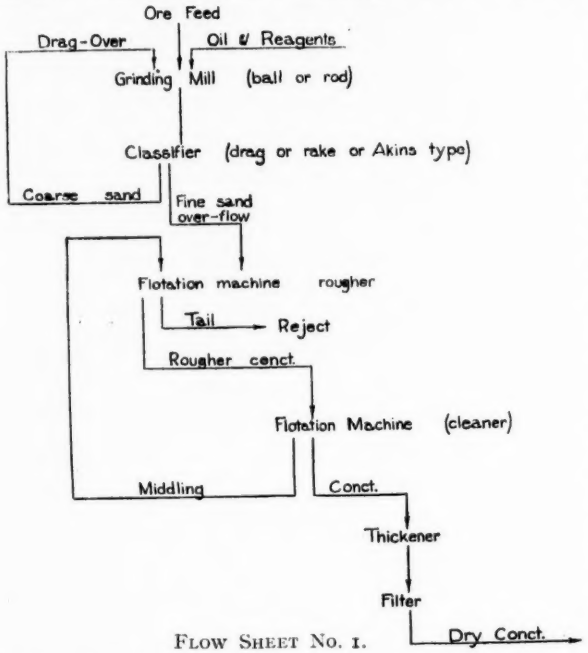
THE art of flotation has developed rapidly. Numerous technical staffs and individual investigators have, by their combined efforts, developed practicable methods of concentrating ores which ten or even five years ago were considered complex and impossible of commercial treatment. Also the work of those who have been engaged in pure research on the fundamentals of flotation has helped greatly to expedite the general development of the process. However, in spite of the highly successful practical operation of the flotation process, results are obtained and things happen that are difficult to explain completely, although much is known about the theory of the process. Quite naturally, as the supply of relatively high grade and easily treatable ores is worked out, the necessity for handling the leaner and more complex ones becomes apparent.

The difficulty of treating the so-called " complex " ores—that is, ores consisting of a number of metallic sulphides highly intercrystallised with each other and with the worthless mineral, has, until quite recently, been a stumbling block in mining operations. There seems to be a tendency on the part of ore dressers to lean too heavily in either one direction or the other. However, those advocating " all flotation " plants predominate. There are many ore-dressing plants in America which use only flotation concentration, and many combination gravity and flotation plants are rapidly going to " all flotation." In order to apply an " all-flotation " treatment the entire ore must be ground to a suitable fineness, generally through a 65-mesh (·208 mm.) screen. Particles coarser than 65-mesh are not readily picked up. On the face of things one is likely to assume that the justification for such fine grinding is the intimate association of the minerals comprising the ore—that is, that there is no " economic liberation " or " unlocking " of the gangue and ore minerals above this mesh. If this is the fact, such a procedure is not only justified but necessary. However, plenty of practice is to be found where careful examination of the ore does not show this to be the case. Often a large percentage of the respective gangue and ore minerals is observed to be completely liberated at sizes of 14-mesh (1·168 mm.) and coarser. On inquiry of the managers, their justification is that they can make more profit by the excessive fine grinding and all flotation method. It is claimed that better grade products and higher recoveries are made. This casts a rather heavy reflection on our methods of gravity concentration, which we are, or have been, accustomed to use on such coarse sands. However, some consolation is to be had in the fact that little effort, relatively speaking, has been made to increase the efficiencies of gravity methods. The highly " spectacular " flotation methods have absorbed our thoughts, and gravity methods of concentration seem to be dying slowly without a struggle. Plants, here and there, are dropping jigs or tables out of their scheme of treatment.

Considerable justification for such a trend in ore dressing may be cited. Some of the advantages of an " all-flotation " plant are (*a*) simplicity of construction and operation, (*b*) low first cost per ton of ore to be treated, (*c*) large tonnage can be handled on a small floor space, (*d*) complex ores require a very fine initial crushing, and if part of the mineral must be recovered by flotation it makes for simplicity to recover it all by the same process; (*e*) two minerals of the same, or nearly the same, specific gravity cannot be separated by gravity methods, and (*f*) high recoveries and good grade products are attainable by the all-flotation method. Flotation is applied with greater certainty than a few years back, and it is surprising to note the large tonnages handled under the observation of a single operator.

Flow Sheets

The simplest form of an all-flotation plant is shown in Flow Sheet No. 1; in fact, this flow sheet represents the best present-day practice where, say, only one mineral concentrate is desired. In some instances the first flotation machine makes a clean concentrate, a middling, and a tailing, the



FLOW SHEET NO. 1.

middling being returned to the head or feed end of the machine for re-treatment. It would be applicable to copper ores of the highly disseminated type, and for ores where a concentrate is wanted because it is valuable for its precious metal content. The precious metals, gold and silver, may be associated with various mineral sulphides, and are segregated from the ore by recovering the sulphides in a float-concentrate. Certain other ores are amenable to treatment by this simple flow sheet. The number of re-treatments of the original rougher concentrate is not limited to one, but may be as many as three or four.

Flow Sheet No. 2 represents a typical all-flotation scheme of concentrating a complex ore consisting of two economic minerals A and B, and is the one that will be most often observed in the plants where best work is being done. While this may be accepted as the general practice, there may, of course, be some modifications or deviations in detail. For example, each rougher concentrate may undergo two or three cleaning treatments in as many individual machines. This is determined by such factors as the nature of the ore and smelter requirements. Where the ore is complex such matters as (1) the type of grinding mill best suited to the particular ore in hand, (2) the type of flotation machine, (3) the type of classifier to give (*a*) best flotation conditions and (*b*) greatest grinding mill efficiency, (4) the reagents to be used and where they shall be added to the circuit, are important details in the successful operation of the plant.

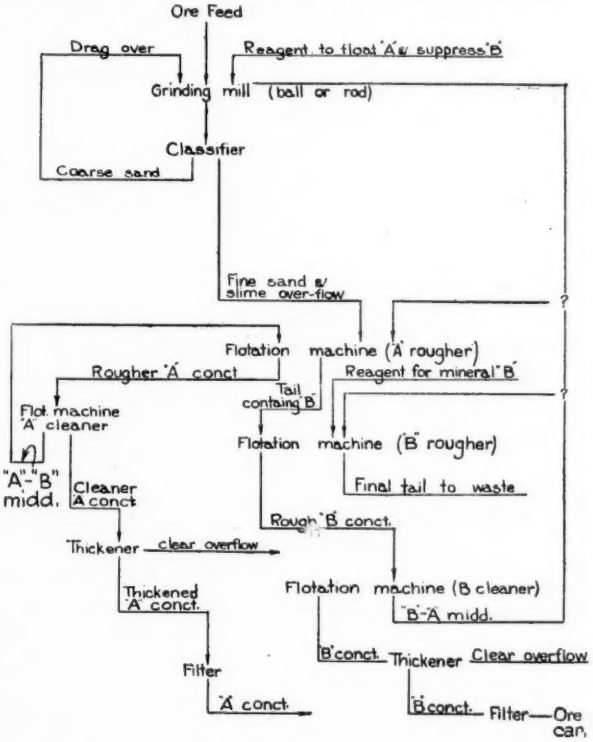
Contaminated Ores

The so-called "contaminated ores" should be differentiated from complex ores. Complex ores are thought of as those ores in which several valuable minerals of different or similar specific gravity are highly disseminated and interlocked with each other and with the gangue minerals. Contaminated ores are those that have associated in them colloid-forming or organic substances that cause them to behave entirely abnormal to flotation. Therefore, a contaminated ore may, and generally does, call for a flow sheet varying somewhat from those described above. There are several proposed methods of treating so-called contaminated ores. One method calls for the use of suitable chemical reagents which may accomplish the desired results in either one of two ways—(*a*) by rendering the colloidal or foreign substances (which may be substances in solution) harmless to subsequent flotation treatment of the ore, and (*b*) by peptising or deflocculating the colloidal material and washing it out by overflow or decantation. There seems to be a large variety of patents covering the removal of colloidal material by deflocculation and decantation. Sodium silicate has been found useful in this connection.

Another proposed scheme is to aerate the pulp, which results in surface concentration of the contaminant. The contaminant is then removed by surface skimming, and the pulp treated as usual. This is based on the assumption that the contaminant lowers the surface tension of water. Organic substances usually do, and they may, therefore, be collected on the surface of bubbles by the process of adsorption. The process is conveniently carried out in a machine that gives intense aeration, using as efficient a skimming mechanism as possible. It is well known that the deslimed part of ground, so-called "contaminated ores," is readily amenable to flotation treatment. In desliming the ore, chemicals should be used to disperse the slimy or true colloidal material as completely as possible, so that it may be thoroughly washed out, carrying with it a minimum of fine sands. True colloidal portions of ores seldom contain much valuable mineral. Certainly the surface tension lowering constituents removed by aeration and skimming would contain no ordinary mineral values.

In a large number of the ore-dressing plants of to-day, flotation is made the primary method, with tables occupying a secondary place in the scheme of treatment. Tables are often used to follow up the flotation machines in some insignificant manner, either (1) to act as indicators of the completeness with which flotation is doing its work, (2) to recover coarse mineral or middling, or (3) to recover a particular mineral that does not respond to flotation and which is worth saving. Often flotation concentrate is passed over concentrating tables for the purpose of making higher grade A concentrate and B concentrate. Generally speaking, tables used in this manner little more than pay for their operation.

It is true that any ore can be ground to the required fineness and the ore minerals recovered by flotation, and mechani-



FLOW SHEET NO. 2.

cally this offers a simple flow sheet. There are, however, factors involved in the treatment of ores other than recovery and simplicity of flow sheet, and, in conclusion, it will be conceded that an ore should be milled by the method that will result in the greatest profit to the operator.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Government Research Report

In the annual report on Scientific and Industrial Research which has now been issued, it is stated that very satisfactory progress has been made in the metallurgy department of the National Physical Laboratory, with an extensive programme of research. Much attention has been given to the conditions for the production of sound castings of "Y" and other aluminium alloys. New methods of heat treatment have been investigated and the properties of aluminium-silicon alloys at normal and elevated temperatures are being examined, while the study of alloys of magnesium with aluminium and other metals has again been taken up. In the case of the work on the iron-oxygen system a special method was developed for producing suitable pots which were not attacked by the alloy. The minor metals research has continued, with special reference to cadmium and beryllium. Work on dental alloys is proceeding, while an investigation into the effect of impurities in copper, the study of special brasses and high tensile copper alloys, and the die-casting of aluminium alloys is in hand for the British Non-Ferrous Metals Research Association. The X-ray examination of alloys and the work on fatigue are being continued.

Metallurgy and Applied Chemistry

The position assigned to the science of metallurgy, at the French Congress of Industrial Chemistry in Paris, was rather striking. The inaugural meeting was, indeed, almost exclusively devoted to metallurgy, and the two principal speakers, Dr. Guillet and Sir Robert Hadfield, were both metallurgists. Moreover, the metallurgical section was, perhaps, the best attended, although its sessions did not extend for quite so long as some of those devoted to other subjects. The point is that metallurgy is now a recognised branch of chemical technology as a whole, a perfectly natural arrangement seeing that the extraction and refining of metals is neither more nor less of a purely chemical operation than the saponification of a fat, or the fractional distillation of an ether, or an essence. It is true that metallurgy embraces the art of working metals, as well as that of reducing and extracting them from their ores. The fact, however, remains that the group classification to which it is nowadays assigned is that of a subdivision of the larger subject of Chemistry—chemistry, that is to say, in its technical and industrial applications. Pure chemistry remains more than ever a subdivision of the newer and all embracing Physics. Chemical industry, on the other hand, is daily widening its field; not only metallurgy, but fuel technology—solid, gaseous and liquid—come under its sway, and the chemical technologist is rapidly becoming more and more indispensable as modern industry develops and progresses.

Producer Gas for Blast-Furnace Working

The conception of a blast furnace as merely a gigantic gas producer of the so-called slagging description is a familiar one. From this point of view the pig iron becomes a by-product, incidentally of equal or greater value than the gases. One is now told by R. Lance, in his paper to the French Congress, that it is a very inefficient appliance for the purpose in view, as 75 per cent. of the fuel consumed takes no part in the furnace reactions involved in the reduction of the iron from its ores, and that the heat required to start and maintain these reactions can more economically be supplied by the gases generated separately in gas producers, preheated to the required degree, and conveyed to the blast furnace, under pressure, to give the thermal conditions upon which the chemical reactions depend for their due development. R. D. Lance is of opinion that producer gas at 1,000°C. will do all that is required and that if it be introduced at the correct furnace level where no risk of its becoming prematurely oxidised occurs, a very considerable saving in the coke consumption could be attained. The furnace burden could then be reduced to merely the amount of carbon (as coke) actually required for the reactions, which is only about 25 to 30 per cent. of the quantity at present employed. All danger of scaffolding or hanging can be eliminated by heating the ingoing gas to the proper temperature, and by reducing the volume of air blown in to the furnace, and ordinary slagging producer practice has, he contends, shown that undue channelling and other troubles can easily be averted if only one goes the right way about things. The air and the gas will require to be heated to the same temperature; the position of the tuyère zone requires readjustment, and as low grade fuel can be employed in the producers, instead of high grade and expensive coke being charged in the furnace, he estimates a net saving of some 10s. per ton in the pig iron, by the adoption of his method. The only point omitted from his paper is whether the process has been tried out on a commercial scale anywhere, and if so, whether the anticipated results—and saving—were, indeed and in fact, accomplished. The slagging producer, with pig iron as a by-product, has already yielded very fair results in practice, and its employment on a far larger scale is by no means beyond the bounds of possibility.

Metal Crystals

On Thursday evening, Professor H. C. H. Carpenter gave the first of a series of four lectures on "Metal Crystals" which he is delivering this month at the Chelsea Polytechnic in London. The lectures are arranged under the auspices of Dr. Charles Dorée, head of the chemical department, and the subject of the first address was "The Crystallisation of Pure Metals." Professor Carpenter first dealt with the crystallisation from the liquid state and the special features associated with the phenomenon. The primary, secondary, and tertiary axes of crystals were then considered in a discussion of the growth of crystals, which, it was pointed out, takes place at the surface of a liquid, in the interior, and in contact with solid surfaces. Some metals crystallise in singularly beautiful forms, being known as arborescent crystals, while others settle out in more than one form and are said to be polymorphic. The microscopic examination of crystals is now one of the methods of examining the properties of metal crystals, and for this purpose the specimen is examined by vertical or oblique illumination. Professor Carpenter's interesting paper concluded with an outline of the systems to which metal crystals belong.

The remaining lectures of the series will be given on November 12, 19, and 26, when the subjects will be "Crystallisation of Alloys (Eutectics, Solid Solutions and Compounds)," "The Plastic Deformation of Metals and Alloys," and "Single Metallic Crystals and their Properties."

The Structure of Pure Iron

A sound knowledge of the differences in iron and steel is of importance to every user of such metals, as it has frequently happened that confused nomenclature has caused

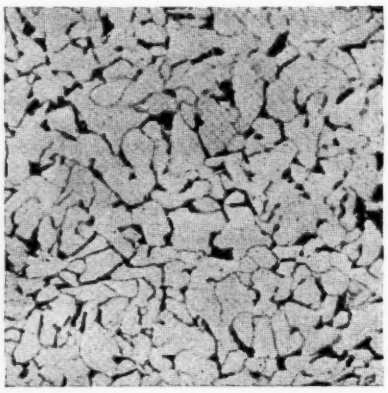


Fig. 1.—Pure Ferrite Grain Structure of Ingot Iron

steel to be purchased when iron was required and even specified. These differences are revealed by a microscopical examination, which contributes materially to an accurate classification of ferrous metals, and the purest iron produced in commercial

quantities is shown by analysis to be ingot iron, which is made by the open-hearth process. As the summation of silicon, sulphur, phosphorous, carbon, manganese and the gases is always less than one-sixth of one per cent. in ingot iron, it is

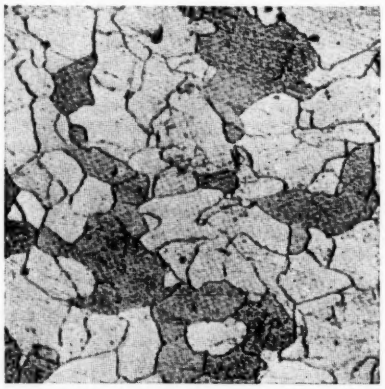


FIG. 2.—STEEL, SHOWING MIXTURES OF PEARLITE AND FERRITE

not surprising that it is extremely difficult to determine accurately such minute quantities of impurities. Whenever larger percentages of carbon and manganese remain in an open-hearth cast, the material becomes less pure and takes on the chemical and physical properties of steel, although Professor Albert Sauveur, a recent Bessemer medallist, has emphasised that ingot iron should not be confused with steel, because its extremely low percentage of manganese gives it entirely dissimilar characteristics, such as brittleness when heated to approximately 850°–1,050° C.

The formation of various types of grain structure is largely dependent upon the carbon content of the ferrous metal under consideration. Pure iron contains carbon in such minute amounts that well annealed samples show a pure ferrite formation (Fig. 1). When the carbon content is increased, as in mild steel, the grain structure shows mixtures of pearlite and ferrite (Fig. 2), until a point is reached where the sample contains approximately 0·9 per cent. of carbon and the grain structure is practically all pearlite. As the carbon increases above this amount, areas of cementite are found. Ingot iron structure therefore differs considerably from that of steel, although it is quite similar to best grades of puddled iron, except that a micrograph of puddled iron would show slag areas which ingot iron never contains.

German Open Hearth Practice

WHAT Mr. Fred Clements has done for British open-hearth furnace practice, Dr. H. Bansen has done, on perhaps a lesser scale, in regard to open-hearth practice at German steel works. A report presented to the steel works committee of German Ironmasters was published some while ago in *Stahl und Eisen*, but does not appear to have attracted much comment, although it contains details worthy of considered discussion. Dr. Bansen collected particulars of a good many more furnaces than were dealt with in Mr. Clements' paper; on the other hand, the data given is nothing like as complete. The investigation was directed to the establishment of some relation between furnace construction and output, but Dr. Bansen was forced to the conclusion that the figures given reveal so many complexities that no fixed rules for either design or practice emerge from the particulars given. Another fact which is of interest in its broad bearings is that high outputs can be obtained with furnaces of very small dimensions, which shows, as the author says, that the furnace by itself is merely a tool, and that output largely depends upon skill in management. The statement is, perhaps, less of an obvious truism than it appears. A small plant, properly worked, is admittedly a more productive unit than a large plant intermittently, or inefficiently, operated. This is not, however, quite what Dr. Bansen means. The point, and indeed several of the facts brought out in the report, deserve rather more study if they are to be made to yield results of value for our own guidance in regard to open-hearth furnace design and working.

German and British Practice Compared

DR. BANSEN has taken the make of tons of steel per hour as the measure of the efficiency of furnace working. Returns are given relating to 59 furnaces, of which 19 are of a capacity of 60 tons or more. The largest had a capacity of 120 tons, but not the largest "tons per hour" output. This was obtained in a furnace of which the original rating is not given, but in which the weight of the charge is returned as just over 60 tons. The tons per hour is given as 9·54, and 12·1 respectively. Taking the furnaces in the aggregate it will be seen that their capacities are not, on the average, greatly in excess of modern British open-hearth furnaces, which should help to dispel the ever-recurrent statement that steel manufacture in this country is carried out in unduly small units. So far as American practice is concerned such a statement is, on the whole, probably correct. So far as German practice is concerned the figures published in Dr. Bansen's report give no sufficient warranty for the belief that, in regard to furnace sizes, German units are as much larger than British units as they are popularly supposed to be.

Details of Outputs and Working

THE highest fuel consumption recorded is in respect of a 65-ton furnace, and a 35-ton furnace, both apparently charged with cold metal, and in both of which the fuel consumption is returned at 470 kilogrammes per ton of steel made. It is noticeable that the furnace with the lowest fuel consumption (215 kilogrammes per ton) was the furnace with the highest hearth-area output of any in the category to which it belonged (40-ton rated). It also had the lowest chequer space but one, almost the lowest weight of chequers, and by far the largest chimney base area for its rating. The distance between ports was short and the height from floor to crown was, relatively, very low. The gas flue length was one of the shortest, and the furnace was one of the oldest, having been constructed in 1901, as a 24-ton furnace. In its long campaign of 425 heats the average yearly consumption of lining material and bricks was the lowest of those respecting which such details are recorded.

Two of the furnaces were working on mixed blast-furnace and coke oven gas, a fuel of which we have not, it may be believed, had any experience in this country hitherto. Apart from furnaces which were admittedly extravagant in their fuel consumption, the figures tabulated in this connection are 220 kilogrammes per ton for minimum practice; 250 kilogrammes per ton for normal practice, and 300 kilogrammes per ton for what the author calls "maximum" practice. Eventually, and after a painstaking analysis of the numerous and rather confusing factors involved, Dr. Bansen arrives at the conclusion that almost as much depends on furnace accessories and general management as on the actual furnace itself. An open-hearth furnace is, he says, but a link in the steel producing plant, and if placed in unfavourable circumstances will work unfavourably from causes in no way due to its actual construction and working.

Proposed Electroplaters' Society

THE need has long been felt for a society in London in which electroplaters and electrodepositors can discuss the problems arising from their work and where they can come into contact with the scientific electrochemists, particularly those engaged in research work on electrodeposition. A society of this character already exists in America, and there are local societies in Birmingham and Sheffield at which plating problems are discussed. At the suggestion of the Council of the Faraday Society, therefore, one of whose objects is to promote the study of electrochemistry and electrometallurgy, a small provisional committee was recently formed under the chairmanship of Mr. S. Field, with Mr. F. S. Spiers as honorary secretary, to take steps to found an Electroplaters' and Depositors' Technical Society. It is now announced that a meeting to inaugurate this society will be held on Wednesday next, November 11, at the Northampton Polytechnic Institute, Clerkenwell, at 8.15 p.m.

It is proposed that all actively engaged in some responsible position in electroplating and electrodeposition should be eligible for membership and that meetings of the society will be held at the Institute, probably on Wednesday evenings. It is expected that a subscription of 5s. per annum will be sufficient to cover the working expenses of the society.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

In many respects October has been a month of contrasts. There has been a good deal of optimism about, particularly in the early part of the month, and there were many signs which seemed to foretell the beginning of the revival which is usually experienced in the closing quarter of the year. Yet we have once again witnessed a downward move in prices in certain sections of the market, which one would think could only be the outcome of a policy of despair. Optimism with anything of a substantial basis might be expected to keep prices firm at least, and it does seem a mistake to slaughter prices at a time when the general tone is undoubtedly brighter.

Better European Outlook

There is more than one reason for this optimistic feeling. It has become a custom to look for an improvement in trade after the summer holidays are over and we are entering on the last quarter; but beyond this the market has certainly been stimulated by the Pact Agreement at Locarno. That has at least brought into view a settlement of the troubled conditions which have so long disturbed the peace of Europe. It brings us to the eve of a resumption of normal relations between the nations, which will permit of business being done in a freer and more normal atmosphere. Unfortunately the beneficial effect of this settlement has been somewhat marred by the storm in French politics. The franc has fallen to an exceptionally low figure, and this unsettlement of financial conditions has once again adversely affected business. There is the possibility of increased competition from the continent, as every fall of the franc offers the temptation of lower prices to the more speculative buyers of continental material. It is really time for France to put her house in order and cease to be a stumbling block in the way of a return to a healthy economic condition.

When one begins to look for the real evidences of an improvement in the iron and steel trade the result is rather a disillusionment. There is no better trade at the moment. There was an appearance of it on the North-East Coast due to the large order for 36,000 tons of pig iron for America, but that order hardly affects the real condition of things, as it is for delivery over twelve months, and is at a price which leaves no margin for the maker. Again, the recent all-round advances in the prices of iron and steel shares have been hailed as a sign of better trade, but they are not. The fact is that these shares had fallen so low that there were very few sellers, on account of the sacrifice involved. As soon as the Locarno agreement was reached, the better prospects opened up brought about a demand for some of the better iron and steel shares which were considered to be as low as they were likely to go, and this was quite sufficient to cause the rise in values. Already this advance is subsiding. Indeed, if one faces the actual position, it has to be admitted there was nothing to warrant the movement. Orders are still scarce, and there is no abatement of the competition for whatever work is given out. In the home market the consumer has the upper hand all the time. If he has a good order to give out he can almost fix his own price.

High Production Costs

The truth is that the causes of the depression in the iron and steel trade are too deep-seated to be removed by a feeling of optimism engendered politically. Our production costs are too high, not only in iron and steel manufacture but in the coal mines, on which the steel trade is so dependent. Selling prices are too low, not from the point of view of getting orders but in comparison with our artificial costs. Taxation, wages paid to sheltered industries, the unemployment benefit, all these things have their share in bringing about this unnatural position; and it has been no help but rather a hindrance that so many works indulged in wide schemes of expansion in the boom times, which have left them with a capacity altogether in excess of the normal demand. But we have once more to say that the fundamental cause of our trouble is the loss of output due to the slackening of the will to work. That is probably more noticeable in the coal trade than in any other. We have unparalleled advantages which, if we used them rightly, would ensure to the collieries, both masters and men, prosperity for years to come, but we are losing them through this fatal tendency to be actuated by the principle of less work for more money.

We believe that the sanei of the men's leaders are anxious to see the depression and unemployment relieved, but the extremists, who unfortunately appear to have considerable influence, apparently would like to see still greater depression and unemployment in the hope that this would bring them nearer to the industrial upheaval which they are so fond of ranting about. Their influence in this matter cannot be ignored. Already its effects are visible, and unless reason can be made to prevail now, the ultimate issue will be disaster to the heavy trades. Special attention was recently called to the parlous state of the steel trade by the publicity given to the legal proceedings to recover the municipal rates from the United Steel Co., Ltd., for one of their subsidiary works. It is significant when a firm of this magnitude has to voice its protest in such a way, but we are afraid this action will pass unheeded.

Important Foreign Contracts

It is some consolation to know that there have recently been some important contracts placed with British firms which will mean more work for the steel makers. Dorman Long and Co. have secured the order for a steel bridge over the Nile, and the steel work will be produced at their plant in Middlesbrough. The Horseley Bridge and Engineering Co. have received an order for Nigeria which will take 4,000 tons of steel and cast-iron work. Some of the railway carriage and wagon building firms have also obtained orders which will result in increased work for the rolling mills. It is reported that the Redbourn Hill steelworks, which have been closed for a long time, are to be restarted; also that the new plant at the Appleby Iron Co.'s works, particularly the new plate mill, is to be completed. It is difficult to see any grounds for increasing the capacity for plates at present, as the steel plate trade is about the weakest section of the market. As against these reports, there is no satisfaction to be derived from the news that the Wigan Coal and Iron Co. are ceasing production for the present, and are going to carry on solely with the stocks they have accumulated.

Price Cutting

The pig iron market has, if anything, shown a slight improvement. There has been no advance in prices, but, on the other hand, there does not seem to be such readiness in cutting prices to secure orders, and a good deal of buying has been done at the present comparatively firm prices. The large American order which we have referred to earlier on may have induced buyers to come into the market. Hematite is also firmer and it does not seem likely that the present prices will be reduced. The large stocks of both foundry and hematite iron accumulated in the makers' works have been responsible for much of the price cutting that has gone on, and until they are still further liquidated it is not probable that there will be any advance.

There is more competition in the finished iron trade since the termination of the arrangement which secured to each district its own market. Prices are being cut to meet the inter-county competition, and there is a little more business doing, although the continental prices still are altogether beyond reach of the British makers. Steel plates are the worst feature of the market. There seems to be no limit to the lengths to which some makers are prepared to go in order to obtain work. When the price fell to £8 10s. it seemed that the bottom had been reached, but very soon orders were being taken at £8 5s., and before long £8 became the recognised market price. Now even that figure has been abandoned, and prices varying from £7 17s. 6d. down to £7 10s. are the rule. Some merchants are actually accepting contracts for British steel plates at £7 10s. delivered, with a heavy carriage rate! There is little change in steel bars and sections, but prices are not very firm.

The production figures for September show an improvement. The pig iron output was 448,700 tons as against 444,500 tons in August. The steel output was 638,900 tons compared with 477,100 tons in August. This is the highest figure for steel since May. It is to be noted that there were seven blast furnaces less in operation than in August, three having been put into blast and ten damped down or blown out.

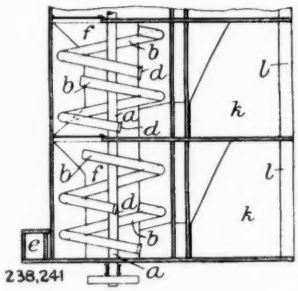
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Concentrating Ores

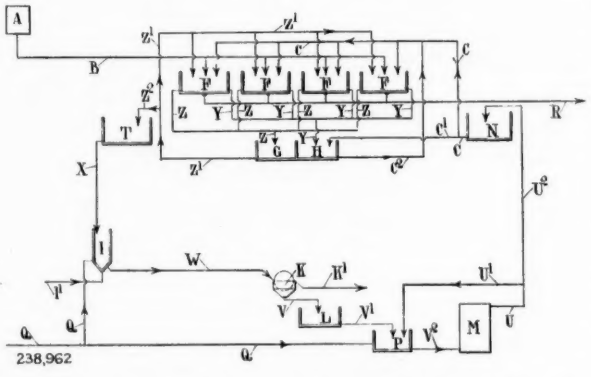
IN the flotation concentration of ores, air is exhausted from or introduced into the pulp by a device which also agitates the pulp. The pulp passes through a series of agitating vessels *f* shown in plan, each being provided with a rotary helical tube *b* with a flared mouth *d*. Air is introduced through the



hollow shaft *a*, and helical tubes, and froth overflows from the spitzkasten *k* at *l*. Tailings are returned to the bottom of the vessels *f* for re-treatment. See Patent application 238,241, by Bamag-Meguin Akt.-Ges., of Berlin, having the International Convention date, August 6, 1924.

Treating Copper Ores

A COMPLETE electro-chemical process for producing refined electrolytic copper from sulphide ores, concentrates or residues, has been patented by H. S. Mackay, of London. The ore is roasted under conditions to ensure that the greatest possible proportion of the copper is rendered soluble, without regard to the amount of undesirable constituents such as aluminium and iron also rendered soluble. The roasted ore is leached with sulphuric acid, the impurities precipitated, and the



remaining solution electrolysed to deposit copper and regenerate sulphuric acid. The precipitation of undesired metals and neutralisation of acid is effected by treating with an oxidising agent and with calcium carbonate sufficient for the purpose, so that only a small amount of copper is precipitated. If the solution does not contain combined acid in excess of that necessary, the iron and aluminium are precipitated by adding copper oxide or carbonate ore, or copper hydroxide with an oxidising agent such as air. The roasting of the ore can be carried out in a standard 7-hearth rotary rabble furnace, but it is preferably modified by drawing off the gases formed in the lower hearths so that they do not pass through the upper hearths. The temperature may vary from 350° C. in the upper hearth, to 575° C. in the 5th hearth, falling to 350° C. in the 7th hearth. The liberated sulphur dioxide can be used in the manufacture of sulphuric acid.

One method of operating the process is shown in the accompanying flow sheet. Roasted ore is delivered from a furnace A by a cooling conveyor B to leaching tanks F where it is treated with sulphuric acid supplied through pipes C. Spent acid is drawn off through pipes Z to a tank G, or through pipes Y to tank H if the solution contains a higher percentage of acid. The low percentage acid in the tank G is used as a first leaching solution, circulating through pipes Z^1 to the tanks F, and finally passing to tank T. The acid in tank H is brought up to required strength by adding acid solution from tank N, and is then passed through pipes C^3, C for use in the tanks F as a second leaching solution. The solution of metals passes to a tank I where it is heated and agitated, and calcium carbonate added to precipitate iron and aluminium, but only traces of copper hydroxide. The latter is redissolved by adding acid. The mixture passes through a pipe W to a filter press K, and the filtrate is collected in a tank L from which it passes to a tank P where free acid may be added through pipes U, U^1 to standardise the electrolyte. The solution is electrolysed in plant M with lead anodes and copper cathodes, and the resulting liquor is used partly for standardising the electrolyte, and partly for leaching the ore. See Patent No. 238,962, dated May 29, 1924.

Reducing Ores

A PROCESS for reducing iron ore by means of pulverised fuel has been patented by R. L. Gamlen, of Hyderabad, India. Pulverised fuel is sprayed into the combustion chamber, and the air for combustion is heated to a very high temperature (800° C.) at a pressure which may be below atmospheric, and caused to mix with the fuel so that an intensely hot flame is produced. The partly reduced ore and slag produced in the reducing chamber are acted on by the flame, producing nearly pure carbon monoxide. This gas is then drawn through the ore and flux in the reducing chamber at a pressure below atmospheric, thus partly reducing the ore, and the ore then passes on to the melting face where reduction is completed. Some of the heat in the carbon monoxide may be used to preheat the air supply. See Patent No. 239,557, dated March 15, 1924.

Extracting Metals

A PROCESS for extracting metals from their ores, which avoids the disadvantages of the usual chloridising processes, has been patented by L. Venn-Brown, of Longueville, New South Wales, Australia. Iron chloride is heated to 150°-200° C. in an oxidising atmosphere and in presence of water vapour to convert it into ferric oxide and hydrochloric acid. The latter gas is used for treating the finely ground ore, which is then dried at 150°-200° C. The soluble chlorides are leached out, and the metals recovered in any known manner. The chlorine is recovered on scrap or metallic iron, or iron oxide obtained by decomposition of iron chloride, and the iron chloride so obtained is used again. If the ore contains arsenic, iron may be added before treatment, to form an insoluble iron-arsenic compound. The character of the leaching liquid employed depends on the metals present, *e.g.*, if lead, silver, or copper are present, sodium, calcium, or magnesium chlorides may be used. In an alternative method, the ore may be mixed with iron chloride and heated together in the presence of steam, or the ore may be ground in iron chloride solution. See Patent No. 239,720, dated October 6, 1924.

Iron-Copper Alloys

ACCORDING to an invention patented by Orkla Grube-Aktiebolag, of Lökken Verk, Norway, an iron-copper alloy is washed with molten lead, yielding a lead alloy rich in copper, and iron comparatively free from copper. The lead alloy may then be treated to recover the copper, and the lead is used again for treating more iron-copper alloy. Carbon is sometimes added to the iron-copper alloy before treating with lead. See Patent No. 239,768, dated January 17, 1925.

Iron Alloys

A RUSTLESS alloy having a good malleability which has been patented by C. H. Thompson, of Worcester, and N. Martin, of Wolverhampton, consists of iron containing carbon 0·06-0·12 per cent., silicon 0·4-0·8 per cent., chromium 10·0-14·0 per cent., nickel 2·0-3·1 per cent., and tungsten 0·15-0·24 per cent. See Patent No. 240,068, dated March 6, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The manufacture and uses of stellite. W. H. Losee. *J.S.C.I.*, September 4, 1925, pp. 451-452 T.

A contribution to the study of ferro-nickel alloys. M. Peschard. *Rev. Metallurgie;* Part II, September, 1925, pp. 581-609 (in French). A magnetic investigation of these alloys.

The inner structure of alloys. W. Rosenhain. *J. Roy. Soc. Arts;* Part I, October 9, 1925, pp. 1,000-1,021; Part II, October 16, 1925, pp. 1022-1037; Part III, October 23, 1925, pp. 1039-1052.

ALUMINIUM. The behaviour of non-homogeneous aluminium castings on cold rolling. E. Seidl and E. Schiebold. *Z. Metallkunde;* Part II, September, 1925, pp. 283-288; Part III, October, 1925, pp. 320-328 (in German).

ANALYSIS. Rapid determination of phosphorus in bronze. W. E. Baulieu. *J. Ind. Eng. Chem.*, September, 1925, p. 908.

The estimation of mercury in cinnabar and the like. E. Rupp and K. Müller. *Z. anal. Chem.*, Nos. 1-2, 1925, pp. 20-23 (in German).

CORROSION. Zinc and the problem of corrosion. Part II. A. Billaz. *L'Ind. Chim.*, October, 1925, pp. 440-442 (in French).

GENERAL. The chemical stability of a number of metals and alloys, particularly alloys containing molybdenum. W. Guertler and T. Liepus. *Z. Metallkunde*, October, 1925, pp. 310-315 (in German). Summarises the behaviour of certain metals and alloys to treatment with acids, alkalies and salt solutions.

ELECTRO-DEPOSITION. Studies on electro-plating. Part VI. Barrel-plating. W. E. Hughes. *Metal Ind. (Lond.)*, October 23, 1925, pp. 379-382 and October 30, 1925, pp. 403-405. A comparison of the types of plating barrels.

IRON AND STEEL. Facts and principles concerning steel and heat treatment. Part III. H. B. Knowlton. *Trans. Amer. Soc. Steel Testing*, October, 1925, pp. 484-506. A description of annealing processes.

Part I.—Some notes with reference to the author's association with French metallurgy (1889-1925) and the important part played by France in the past. Part II.—Some curious and unexplained facts connected with manganese steel. R. Hadfield. *J.S.C.I.*, October 23, 1925, pp. 1029-1044.

Chromium-nickel rustless steel. W. H. Hatfield. *Metallurgist*, October 30, 1925, pp. 151-154. A new steel having an extended range of resistance to corroding media.

Testing the hardness of hardened steels. R. Mailänder. *Stahl u. Eisen*, October 22, 1925, pp. 1769-1773 (in German).

Electric heat-treating furnace applications. E. A. Hurme. *Iron and Steel Engineer*, September, 1925, pp. 357-368. The application of electrical heating to metallurgical operations.

Graphite in cast iron. Part I. *Metal Ind. (Lond.)*, October 30, 1925, pp. 411-414.

ZINC, COPPER. The electrothermic zinc industry. M. Canaud. *Rev. Metallurgie*, September, 1925, pp. 571-579 (in French). A review of recent progress in the electrothermic metallurgy of zinc.

Copper refining and zinc smelting. *Ind. Chem.*, October, 1925, pp. 425-433. As carried out at the Swansea works of the British Copper Manufacturers, Ltd.

Bauxite Discovery in Hungary

REPORTS from Budapest state that the Hungarian National Geographical Institute have discovered bauxite near the surface in the Bakony and Vertes district. For the exploitation of the fields a joint-stock company has already been formed, and two factories are to be erected for the production of aluminium.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W. Registered September 21, £1,200 and £2,000 B Debentures, and £6,500 C debentures, parts of £250,000 and £500,000; general charge. *£1,002,040. October 22, 1924.

BOLCKOW VAUGHAN AND CO., LTD., Middlesbrough, iron masters. Registered October 19, £322,000 debentures; general charge ranking as a 2nd charge. *£2,363,776 8s. November 13, 1924.

BRITISH CHILLED IRON AND STEEL CO., LTD., Barrow-in-Furness. Registered September 29, £1,000 debenture, to T. Todd, Westville, Grainger Park Road, Newcastle-on-Tyne, merchant; general charge. *£6,000. March 26, 1925.

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd. Registered October 14, £500 debentures, part of £10,000; general charge. *£3,859. July 24, 1924.

INDUSTRIAL STEELS, LTD., Sheffield. Registered September 23, £210,000 debentures (including £180,000 already secured) and £50,000 2nd debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issues £30,000 and £26,000; general charge. *£215,000. August 16, 1923.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield. Registered September 24, £1,850 debentures part of amount already registered; general charge (except uncalled capital, etc.). Registered October 5, £5,600 debentures, part of £750,000; general charge (except uncalled capital, etc.). *£500,000. October 13, 1924.

Copper as a Super-Conductor

Possibilities of great scientific interest have been disclosed by the experiments of Dr. W. P. Davey, of the American General Electric Co., according to a report we have received from the Engineering Foundation, New York. Dr. Davey found by calculations, based on the arrangement of the copper atoms which the X-rays revealed, that copper composed of a single crystal should have a conductivity 14 per cent. greater than ordinary copper, greater even than that of silver, which is the only known material with higher conductivity than copper. Dr. Davey made single crystals of copper by very gradual heating and cooling pure copper in an electric furnace. When molten metal is quickly cooled, very small crystals are formed; if the melt is cooled slowly, the crystals are larger. The melt was cooled so slowly that only one crystal was formed, and that included all of the metal. By this method, single crystals three-fourths of an inch in diameter and six inches long were produced, as well as one fourteen inches long. The conductivity of these crystals agreed within one-quarter of one per cent. of the calculated value.

The large crystals grow in such a direction that the atoms are arranged in columns along the length of the crystal. It is this regular arrangement of the atoms, which, it is believed, gives to the single crystals their superior conductivity when compared with ordinary copper, in which the crystals are small and the arrangement of these small crystals quite chaotic. There is reason to believe that the conductivity of copper crystals along another axis from that measured may be even 60 per cent. greater than the value for pure copper, but the growth of single crystals along this other axis has not yet been brought under control. This newly-discovered high conductivity has not yet been utilised commercially, as the single crystals are very delicate and difficult to manufacture.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Antimony: its Metallurgy, Alloys and Compounds

By G. Malcolm Dyson, B.Sc., Ph.D., A.I.C.

ANTIMONY is a metal which, although not used alone to any great extent, is nevertheless in considerable demand for the manufacture of its alloys, and for its compounds which find considerable employment in industry for the manufacture of pigments, medicinal compounds and mordants. The metal has been known for a considerable time, since it is one of the easiest elements to extract from its ores; and an early

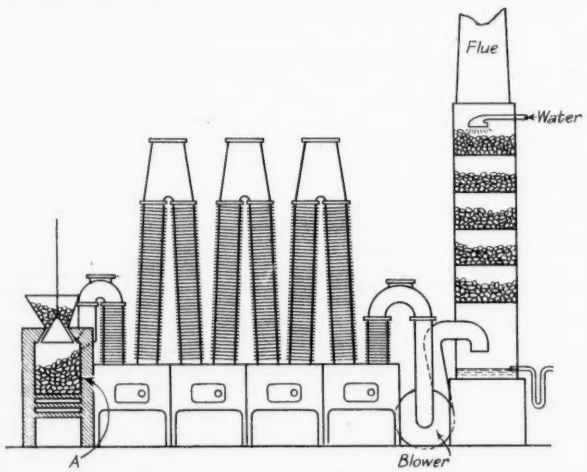


FIG. 1. HERRENSCHMIDT OXIDISING PLANT

Chaldean vase analysed by Berthelot in 1887 was found to consist of almost pure antimony.

The element is comparatively widely distributed naturally, and has been found native in scaly masses. It occurs, together with arsenic, in a large number of cupriferous and plumbiferous minerals, as, for example, in:

Pyrargyrite, $3Ag_2S.Sb_2S_3$,
Boulangerite, $5PbS.Sb_2S_3$,
Bournonite, $2PbS.Cu_2S.Sb_2S_3$,
Allemontite, SbAs,

but the chief ore of antimony is the sulphide, Stibnite, Sb_2S_3, the other ores being comparatively rare. Stibnite or "antimony-glance" varies from about 20–90 per cent. purity, and when of 90 per cent. (or more) is treated as pure antimony sulphide for purposes of metallurgy. The residue is mainly quartz with a small proportion of earthy matter.

Extraction of the Metal

The procedure to which the ore is subjected depends on the product required, for since the oxide and sulphide of antimony are in more considerable demand than the metal itself, much of the element can be extracted from the ore in the form of these compounds, without the actual isolation of the metal. Where the metal itself is the object, several processes are available. Both wet and dry processes have been devised for the separation of the metal, but up to the present the dry ones are the only methods which can be said to be commercially efficient. The most promising of the wet methods is the electrolytic process, in which the ore is first ground to a 20 mesh, and then extracted with 2 per cent. aqueous caustic potash solution at 100° C. The solution so obtained is electrolysed, using sheet iron cathodes, with a current density of 10–15 amps. per sq. ft. at 2 volts. The antimony is removed from the cathode by "stripping," but it is difficult to get the right conditions for the deposition of a coherent layer of antimony, while the process is costly to operate.

The dry methods in use are two—the "sulphide" and the "oxide" processes. In the "sulphide" process the ore is first crushed to walnut size, and heated in a liquation furnace, when the antimony sulphide melts and is separated from the gangue. The older works still use large earthen pots for this part of the process, holes being provided in the bottom of the pot in order to allow of the molten sulphide running away; but the more modern practice is to use a vertical tube furnace, the ore being fed in at the top, and the molten sulphide and spent ore being discharged from separate orifices at the bottom. Again, in some of the continental works an open reverberatory hearth is used for the liquation. This process yields an antimony sulphide (the "crude antimony" of the smelter) of about 95 per cent. purity, but has the disadvantage that about 20 per cent. of the original antimony sulphide is left behind in the residue. An average sample of waste from the liquation plant showed on analysis:

	Per cent.
Antimony sulphide	20·4
Iron sulphide	4·10
Silica	59·84
Alumina	4·6
Calcium oxide	5·27, etc.,

so that unless this residue can be treated, *e.g.*, by roasting for oxide fume, the liquation process occasions a serious loss of raw material.

The Sulphide Process

To obtain the metal from the sulphide the latter is melted with scrap iron (de-tinned tin-plate scrap is preferred) and salt in crucibles at a bright red heat. The reduction to antimony takes place in about an hour and a half, after which the contents of the pot are poured out into a conical mould. The metal so obtained is known as "singles" and contains about 92 per cent. of antimony. In continental practice the "singles" are obtained straight away from the ore. It must be pointed out, however, that here the ore is carefully hand-sorted, and is about 90 per cent. pure—calculated as antimony sulphide. The charge of ore (¼ ton) is mixed with charcoal (¾ cwt.) and Glauber's salts (1 cwt.), and thrown on to the red-hot bed of an egg-shaped reverberatory furnace. After about four hours the charge begins to melt, and carbon monoxide is evolved, giving the charge the appearance of boiling. The charge is rabbled for one and a half hours, and allowed to cool to a dull red heat, when the semi-solid slag is tapped off. Further quantities of charcoal and Glauber's salt are now added, when reduction takes place and the metal is run off as "singles" after a further period of one and a half hours. The singles are then submitted to a purification process known as "doubling," in which the raw metal is fused for about the same time with stibnite and saltcake.

The second or "oxide" process gives a metal of the same purity as "doubles" straight away. The sulphide is roasted on the hearth of a reverberatory furnace, when sulphur dioxide and antimony oxide are produced. The actual oxide obtained depends on the air supply. A full supply gives

the tetroxide, which remains on the hearth as " heavy oxide," while a more restricted air supply leads to the formation of the trioxide, which passes off as " oxide fume " and can be condensed in suitable chambers. The oxide may be used as such, or reduced to the metal by heating with carbon and a flux in earthen pots, when a moderately pure (97 per cent.) antimony is obtained.

Modern Oxidising Plant

The most modern oxidising plant that shows consistently good results is that of Herrenschmidt (Fig. 1) in which the stibnite itself is roasted to " oxide fume." The ore is first crushed to a walnut size, and mixed with charcoal. The amount of charcoal used depends on the stage of the process. At " starting up " about 6 per cent. is used, but as the furnace gets hot, and the charge on the hearth well alight, this amount is decreased to 2 per cent. The mixture of ore and fuel is charged into the hearth A by means of the hopper, and ignited. The oxide fume is condensed in a series of inverted U-tubes provided with iron " fins " to encourage radiation. The residual traces of " fume " are removed from the gases by spraying water over an inert packing contained in a tower which forms the base of the flue-stack. A rotary blower is interpolated between the condensers and the stack to promote draught. This plant has the advantage that it converts from 90–92 per cent. of the antimony content of the ore to antimony fume, and requires the minimum of labour and fuel. In an actual run, 136 tons of stibnite containing 24 per cent. of antimony (calculated as the trioxide) gave 30 tons of antimony oxide, thus showing an efficiency of 92 per cent., and at the same time demonstrating that a low grade ore, unsuitable for liquation, can be advantageously utilised.

The metal obtained as " doubles " is given a third melting with a special flux, by which some of its impurities are removed. It is then cast into moulds, and the ingots remain covered with slag until completely cold. By this means the surface of the ingot is starred over with crystals of antimony, and the presence of this formation on the ingots called " star-bowls " is taken, in commerce, as a sign of purity. The pure antimony of commerce usually occurs in 8 lb. ingots, and the following is an average of many analyses of the metal from a particular works :—

Constituent.	*Percentage.*
Antimony	98·96
Copper	0·03
Iron	0·29
Lead	0·40
Arsenic	0·08
Sulphur	0·24

The metal is brilliantly silver-white, and when cooled slowly from the melting point occurs in large flat masses of

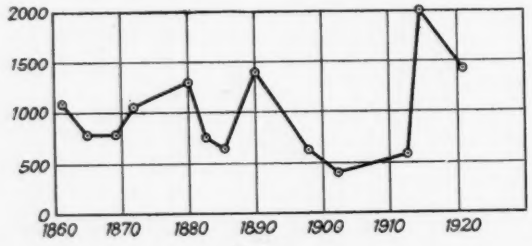


FIG. 2

crystals. These are very obtuse rhombahedra which very nearly approach the cube. The density varies from 6·7 to 6·86, while the metal is hard, and so brittle that it is easily powdered. It burns in the air, when strongly heated, the trioxide being formed.

It follows that a metal of this nature cannot *per se* have many applications, on account of its slight tensile strength, but there is one use of the unalloyed metal that may be mentioned—viz., its use as " antimony black " (which is obtained by the precipitation of the metal from its solution as chloride, by means of zinc) for coating plaster work. When rubbed in and burnished, the antimony gives to the surface a lustre similar to that of iron or steel.

The demand for metallic antimony is steadily increasing, as shown in the accompanying price curve (Fig. 2).

The Alloys of Antimony

The addition of antimony to tin, with or without the addition of a small amount of copper, gives " Britannia metal," which is a bluish-white sonorous metal that takes a good polish, and from which good castings may be taken. The presence of the antimony confers hardness on the alloy, and the tin renders it workable. A typical Britannia metal contains 94 parts of tin, 5 of antimony and 1 of copper, and is used for the manufacture of spoons, and domestic utensils of various kinds where ornament and utility have to be combined. A modified Britannia metal that is tough, and finds various technical applications, is composed of tin, 436 parts; antimony, 36; copper, 12; and manganese, 1. Antimony enters into the composition of most anti-friction metals, and thousands of these alloys are used for various kinds of bearings. Some of the more common types of anti-friction metals are the following :

1. *Babbitt's Original.*—Sn 83·3, Sb 8·3, Cu 8·3, with or without a little aluminium. An enormous number of modified Babbitt metals are now used, to the exclusion of the original alloy.
2. *Magnolia Metal* for ordinary bearings.—Sb 16·45, Pb 83·55, with or without a small proportion of bismuth.
3. *Anti-friction Metal.*—(*a*) For heavy axles, at slow speeds, Sn 72·7, Sb 8·2, Cu 9·1. (*b*) For high speed axles, Sn 17, Sb 77, Cu 6.

Further, nearly all varieties of type metal contain a proportion of antimony, and it is to this element that the type-metal owes its hardness and ability to expand on solidification, this giving a sharp impression of the type. Some examples of English typemetals are :

	Pb.	Sb	Sn
Typemetal A	50	25	25
Typemetal B	60	30	10
Stereotype	86	14	—
Linotype	82	15	3

The typemetal A is expensive and only used for high-class work. The " hard lead " used for linings, etc., in chemical plant contains up to 22 per cent. of antimony, while a small proportion of antimony is added to leadshot to facilitate pouring, and to ensure hardness. An uncommon alloy is Sn 3, Pb 2, and Sb 1, which is used for the manufacture of ships' nails as it resists the corrosion of seawater. Other alloys comprise those with zinc (Cooke's alloys) which correspond to the formulæ Sb_2Zn_5 and Sb_2Zn_3, and that containing an equal proportion of copper and antimony, which is known as " Regulus of Venus," and is of a deep purple colour. In casting antimony and its alloys, care is always taken to cast at as low a temperature as possible, in order to avoid excessive oxidation. As a rule cold moulds, coated with a lampblack-turpentine varnish, are used.

Compounds of Antimony

Several antimony compounds are used as pigments. The oxide, although moderately expensive, gives a very good coloured white, with more body than white lead and greater permanence. For pigment purposes the oxide can be prepared straight from the ore by the Herrenschmidt process, and to obtain the best results should be ground in oil immediately after preparation. The covering power of antimony white is about twice that of white lead, weight for weight.

Almost all shades of red and orange can be obtained from antimony sulphide. A good shade of warm brick red can be obtained by lixiviating the stibnite ore with 2 per cent. caustic potash solution and pouring the filtered extract into a large bulk of dilute hydrochloric acid. The precipitate after washing and drying is ground in oil. " Antimony vermilion " is prepared by mixing solutions of antimony chloride and calcium thiosulphate in large vats. Live steam is then introduced into the liquid, which turns orange and then a deep clear red colour, at which latter stage it is poured into much calcium sulphide solution, when the antimony vermilion is precipitated, and is then thoroughly washed and dried. Care must be taken to stop the action of the steam at the right juncture, as the continuance of its action leads to the formation of a dark red or even brown sulphide. By extracting the ore with 2 per cent. potash solution at 100° C. and treating the solution so obtained with sulphur dioxide from a pyrites kiln, a golden pigment is obtained. Solutions

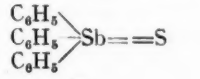
of antimony chloride and fluoride find extensive applications in the calico printing industry, and for the bronzing of metal surfaces.

Medicinal Products

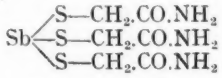
Antimony compounds have been used for over 2,000 years for medicinal purposes, but their use had fallen into abeyance by 1600 to 1650, and it was only in 1906 that Nicolle was led by a consideration of the therapeutic activity of arsenic compounds to suggest their use in the treatment of African sleeping sickness (*Trypanosomiasis*). Since then it has been found that antimony and its compounds are specific in their bactericidal action towards trypanosomes and leishmanioses, so that remedies are also available for the treatment of Kala-azar, dourine, schistosomiasis, etc., while the compounds also play an important part in the treatment of leprosy. The compounds which are used in these connections comprise colloidal antimony, tartar emetic, antimonyl tartrate and malate, and various organic derivatives of antimony. Tartar emetic is obtained commercially by dissolving the oxide, which has been carefully freed from traces of arsenic, in a strong solution of acid potassium tartrate, when tartar emetic separates out on cooling, $[(SbO)K(C_4H_4O_6)]_2H_2O$. The substance "antiluetin"—a potassium ammonium antimonyl tartrate—is prepared in a similar manner. Among the organic compounds of antimony that are of therapeutic interest, the most important is "sulphoform" or triphenyl stibine sulphide (II.), which is prepared commercially by treating the

$$(C_{12}H_{12}O_2N_2As_2)_2 . AgBr . SbO(H_2SO_4)_2$$

I.



II.



III.

corresponding bromide with ammonium sulphide. The triphenyl stibine bromide is obtained by the action of a solution of bromine in petroleum ether on triphenylstibine, which, in turn, is obtained from a mixture of benzene, monochlorbenzene and antimony trichloride by the action of sodium.

For the treatment of diseases due to trypanosomes *gambiense* and *surra*, the compound "Luargol" has been found very effective. Luargol is 3·3¹ diamino-4·4¹-dihydroxy arsenobenzene silver bromide antimonyl sulphate (I.). The only other antimonial of importance is antimony thioglycollic acid amide (III.), which has given encouraging results, but further research is needed to discover the ideal antimonial for the treatment of these diseases.

Pulverised Fuel in Extraction of Zinc Ores

By Hartland Seymour

The three general methods now in use for smelting zinc ores are hand-firing with coal, gas firing, and the third, which is coming more and more into use, is by pulverised fuel. On the old type roaster furnaces and some of the old Belgian smelting furnaces 3¼ tons of good coal were required to smelt one ton of ore. Hand-firing was the only method in use, and there was generally a loss of from 40 per cent. to 48 per cent. arising from incomplete combustion of the coal. The firing of the roasters did not require any exceptional skill in obtaining results during the process of roasting the ore, but in the case of the smelters a different condition existed, with the result that it usually required four years' training before a man could handle the furnace properly without spoiling the extraction and the run of the zinc. The Belgian hand-fired furnaces are usually built with two banks of retorts from seven to eight rows in height.

On the latest type of ore smelting furnaces equipped with regenerative chambers in connection with each furnace there is now being obtained an average consumption of fuel of 1 lb. in gas producers to each pound of ore smelted. This process has again been improved so that there is a reduction in the fuel consumed by the producers of nearly a pound per pound of ore smelted. These furnace regenerative chambers are of the reversing type rather similar to open hearth practice, the regenerated air entering the furnace at a temperature ranging between 300° and 400° F., while the spent gases leave the regenerative chambers at temperatures between 350° and 400° F. The percentage of yield of zinc from the ore is a varying quantity, and it appears to be highest when natural gas is used, the yield then being as high as 83 per cent.

Several concerns, in an endeavour to reduce their fuel costs, have tried pulverised fuel, and several firms have adopted this form of firing for both roasters and smelters with appreciable economy in fuel. In one case the coal is reduced to the fineness of flour and is carried by just sufficient air to project it into the chamber, where instantaneous combustion takes place. The coal is pulverised in one operation and delivered to the furnaces at an expenditure of about 17 h.p. hours per ton of pulverised fuel. The first step is the reduction of run-of-mine coal to a size suitable for drying. This operation is carried out in a single roll mill. The product from this roll is passed over a magnetic drum for the removal of inert matter, when the coal is dried at 260° F., which is hot enough to dry it thoroughly, but not to begin distillation of the volatile products. From the driers the coal is passed to pulverisers which grind it so that 95 per cent. will pass a 100 mesh, and 70 per cent. a 300 mesh sieve. From here the coal is conveyed to a bin at the furnace and then delivered to the burner in a uniform quantity by an automatic feeder.

In the process of pulverised fuel firing, the first constituent of the coal to ignite is the volatile gas. When this has ignited, it raises the temperature to the ignition point of the solid carbon, and before leaving the zone of heated air, every particle has released its heat units. It is quite possible to obtain temperatures ranging between 1900° and 3500° F. in the combustion furnace, and from 1500° to 3300° F. in the furnace proper where the heat treating effect is needed.

A mixture of coal dust particles in the air will not ignite until it reaches a certain density. On the other hand, a mixture that is too rich in coal dust has a tendency to smother. Dust clouds must naturally be avoided outside the furnace chambers, and all sparks and flames must be kept away from the installation. The pulverised fuel should be conveyed to the furnace in as compact a condition as possible, and air currents should not be used if other means are available. There should be no leakages in the conveying system, as they create uncleanness and very often cause accumulation in inaccessible places. Carelessness in handling pulverised fuel and poorly designed installations are the most fruitful causes of "flashes," but there is no danger at all if ordinary care is exercised.

Comparison of Costs

On the old style hand-fired roasters and smelters, records show a consumption of 11,500 B.Th.U. coal per ton of ore treated, or 37,375 B.Th.U. per pound of ore. On the same style of furnace using pulverised fuel as a firing medium, these furnaces are now using 2 tons of 11,500 B.Th.U. coal per ton of ore treated, or 23,000 B.Th.U. per pound of ore, *i.e.*, a saving of 38·5 per cent. for pulverised coal against hand-firing. On regenerative furnaces smelting ore with producer gas, using coal containing 11,500 B.Th.U. per pound, from past practice using 1 lb. of coal in producers per pound of ore smelted, shows that they were then using 11,500 B.Th.U. per pound of ore smelted. As this quantity used has been further reduced by improvement in method to $\frac{8}{10}$ lb. of coal per pound of ore smelted, it shows that these furnaces are now using 9,200 B.Th.U. per pound of ore smelted; and, as we are aware, the minimum of 30 per cent. loss of heat energy exists in gasifying coal in a producer, we can expect to smelt one pound of zinc ore using pulverised coal with a consumption of 6,440 B.Th.U. per pound of ore smelted with the improved method on regenerative furnaces. Results now being obtained show an extraction of 91 per cent. of the zinc in the ore using pulverised fuel. This is due to the fact that a quicker and softer heat can be used at the start after re-charging the retorts, which not only speeds up the operation of extraction, but at the same time increases its efficiency.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Heat-resisting Materials

THE present day is characterised by intensive power production, and in a country such as Great Britain, where steam raised in fuel fired boilers burning, for the most part, raw coal, is the chief source of power, this means intensive steam raising. It is to the metallurgist that the boiler engineer looks for aid in this matter. The efficiency of a modern boiler plant is surprising; 92 to 93 per cent. thermal efficiency is actually reached in some super-boiler installations; 85 per cent. is not uncommon, and while the average, taken over many small plants possessing obsolete boiler equipment, may be as low as from 50 to 60 per cent., 75 per cent. is a much more customary efficiency at most modern works. Such an advance calls for materials having special properties; steam pressures and temperatures run to enormous figures; there is a tendency to use fuel of a kind or in a state in which higher temperatures are reached in the furnaces and on the grates than have hitherto been deemed practicable or advisable. Everything points to an extension in these directions; the leeway we have to make up in competition with countries which have resources of water power which we at home lack. It devolves on the chemist and the metallurgist to supply the refractories and the metals which can withstand the intense heat; the sulphurous vapours given off by the poorer coal we are being forced to utilise, and the corrosive and scaling action of high ash fuel, coke, coke breeze, coal and blends of all kinds, which will have to be used increasingly in the future.

Chromium-Nickel Alloys

THE ordinary metals we have been in the habit of using will not do. Cast iron has a habit of growing, which makes it unsuitable for the fire bars of the immediate future. A host of requirements have to be met. Fortunately, metallurgists have, for the most part, foreseen the tendency and are ready to meet the demand. Much work has been and is being done, but much of the material is appreciably more costly, and many potential customers are in some doubt whether to incur the extra cost, and whether that cost will be commensurate with the economies effected by this more intensive steam raising practice. Chromium-iron and nickel-chromium-iron are expensive materials, but silicon iron is not so dear. With increased demand for all these materials it is not surprising that there should be a great deal of painstaking research going on on the subject of the behaviour of metals at high temperatures. In regard to other applications at, for example, chemical works, the demand is for non-corroding materials, and the temperatures employed are, in most cases, very much lower.

Viscosity of Metals at High Temperatures

THE results of some very interesting investigations on the viscosity of certain alloys at high temperatures were given in a paper presented to the Academy of Sciences in Paris by J. Cournot and K. Sasagwa. The property is one which differs from those actually required in such metals, but is connected with it and has a distinct bearing on the general problem involved, as it is directly connected with the tendency to creep. When an alloy is subjected to tensile stresses at high temperatures, it will, if the stresses are below the maximum stress of the material, elongate at a rate which tends towards a constant, characteristic for the particular metal under test, of the temperature and the load. At a given temperature this constant, in the case of stresses below a certain value, tends to zero, and indicates the limit of viscosity of the material at the given temperature. The authors have devised an apparatus to ascertain the facts in question. The alloy under investigation is tested in the form of a wire, about 1 millimetre in diameter, as this form serves to avoid the variations in homogeneity and in chemical composition which might intervene in greater thicknesses of metal. The stress is applied in a way which allows of its being accurately measured, independently of any reduction in section, and the elongation-time curve is recorded automatically. The apparatus has been employed to determine the rates of flow under varying stresses, and hence the limit of viscosity for a number of metals, including high speed steel with 14 per cent. of tungsten; nickel-chromium steel with 63 per cent. of nickel and 11 per cent. of chromium, and silico-chromium steel with 2 per cent. of silicon and up to 12 per cent. of chromium. The characteristic flow-rate is very high for some of the special alloys. At from 300° C. to 500° C. the viscosity curves, on being prolonged, intersect the maximum breaking stress, a feature which explains the failure of such metals at high temperatures, or at temperatures above that at which this intersection of the curves takes place. Once this point is reached the viscosity curves fall rapidly. This indicates the careful control which is needed in practice, when metals industrially employed attain, during working, temperatures commensurate with those at which experiment shows this flow to occur. Thus at 700° C. for a mild steel, when the breaking stress is about 11 tons, the viscosity limit falls to about 1 ton. In the case of rapid steel, it falls from 36 tons to 7 tons; and in nickel-chromium steels from 42 to 17 tons. Rapid tool steel is greatly superior to ordinary steel, but inferior to nickel-chromium steel. Silicon-chromium steel is slightly superior to the latter at about 575° C., but becomes more fluid above this temperature, and at about 700° it approximates more closely to high speed tool steel.

Strength of Metals at High Temperatures

THE experiments and details described above relate, however, to temperatures far lower than those attained in many operations. Much work has been done at higher temperatures, and a number of well-tried high temperature resisting metals have been put on the market. Era H.R. steel is a typical material of this class, and is one of several brought to a very high degree of perfection by the Research Department of Hadfields, Ltd. Sir Robert Hadfield, himself a pioneer in special and alloy steel investigations, has described the nature and behaviour of some of these materials from time to time. The "Era" steel is non-scaling, up to and even above 1,000° C., and even at temperatures approaching 1,300° C. it offers considerable resistance to wastage by oxidation. Moreover, it withstands the action of sulphur and maintains its tensile strength to the high standard of 19 tons per square inch at 900° C. At stresses below the maximum such slight creep as may occur is not sustained, and in a few hours the material resumes its former rigidity. In these circumstances it is not surprising to learn that boiler makers and furnace designers are availing themselves more and more of the many valuable qualities which "Era" H.R. steel displays in comparison with ordinary steel. It is being employed for furnace racks and plates, carbonising boxes and pyrometer sheaths, and for nozzles, muffles, etc., as well as for many other uses. Indeed, there is little limit to the application of these and of corrosion resisting materials in the hundred and one uses which modern industry employs in furnace work, and in chemical engineering where such material is often indispensable. This is one of the considerations in which a relatively higher cost is an almost negligible factor. The need for good, reliable and efficient service stands first, and all other considerations become, so far as true economy is concerned, subsidiary.

A New Magnesium Enterprise

FOLLOWING the article on magnesium in last month's metallurgical section of THE CHEMICAL AGE, it is of interest to note that a new company has been formed to exploit the metal. Many years ago, when its uses were confined to such purposes as photographic ribbon and powders, or for pyrotechnical needs, the metal was produced at a small works at Patricroft, Manchester. Later on, as the article indicated, it was manufactured in greater quantities by the British Magnesium Co., at Wolverhampton. A further development is now taking place, Britisb Maxium, Ltd., having been formed to exploit the Michel Process, and by a curious coincidence the works at which the operations will be carried out are at the old home of the metal, at Patricroft. The demand for magnesium die pressings, and for the extended forms in which it can be produced by the Michel process, exceeds the supply; but it is hoped that this phase will be only a transient one, and

arrangements are in hand to increase materially the production. Unlike aluminium, of which, in the early days of mass production, the supply was well in excess of the demand, which had to be created, the demand for magnesium exists already, the metal having established its value in a number of engineering applications. With such a situation it cannot be long before its price becomes so greatly reduced as to enable its use to be extended in a number of other directions in which lightness and strength are required.

Iron, Steel and Electricity

In the eighth annual iron and steel number of *The Electrician*, published on November 27, the advantages of electric power to the iron and steel industries are discussed. It is pointed out that by far the greatest proportion of the coal they consume in the production of pig iron, the starting point of the industry, is converted into power gas, either in the preliminary process of coking the coal required in blast furnace practice, or in the secondary process of smelting the ores by means of the coke produced. They are, therefore, in the unique position of being not only consumers of coal, but of having, as a by-product, most of the power they require for the subsidiary operations of producing iron and steel in its finished and marketable forms. The question naturally arises, are these industries using all their coal in such a manner as to get all they can out of it? The best way of generating the power required in iron and steel works, it is suggested, and, in the long run, the most economical, is to devote to the production of electricity as high a proportion as possible of the fuel consumption of the industry.

It has become almost a habit of late to deplore that Great Britain is not a mountainous country, like Norway, or Northern Italy, or Switzerland or Eastern France, but as a matter of fact hydro-electric development has had an altogether exaggerated importance ascribed to it by many people in this country. In the United States at least 60 per cent. of the electric power developed is generated from the combustion of coal. Belgium, which has double the per capita consumption of electricity that this country has, is altogether devoid of water-power stations. In Germany it has been estimated that 90 per cent. of the electric power employed is derived from steam or gas engines, so that the great bulk of electric energy developed abroad is still generated by burning coal.

Copper Activity in Canada

A report received from the Dominion Department of Mines, Ottawa, states that it is expected that the total production of copper in Canada during 1925 will largely exceed that of any previous year. The output in recent years averages between fifty and sixty thousand tons of blister copper and copper matte per annum, a quantity of which is refined in Canada. The increased demand and the subsequent rise in price have stimulated activity in the mining and smelting of the metal. In the Sudbury region of Ontario great activity has persisted throughout the year and the copper derived from the treatment of the nickel-copper ores of this area will amount to about twenty thousand tons for 1925, two-thirds of which will have been refined in the Dominion, the balance being exported to the United States and Great Britain in the form of blister copper and copper-nickel matte.

In Quebec, operations have been carried on by the Eustis Mining Co. at Eustis, with an increased production due partly to the application of an improved method of selective flotation for treating the copper ores. The very encouraging results met with in the development of the Rouyn areas of north-western Quebec, notably at the Noranda, Amulet and Waite properties, and the assurance of railway and good road facilities, indicate great prosperity for this new mining region. The copper ore discoveries have been accompanied by finds of important deposits of gold and of zinc ores. The coming year will probably witness the erection of smelter and milling plants, as well as the construction of a branch railway which will follow a line in proximity to the most important known deposits. The outlook for increased copper production from Canadian deposits is thus very encouraging, and with copper at a reasonably high price a renewal of operations in the Pas mineral belt in Nothern Manitoba is to be expected, where large deposits have been proved. Confidence is also felt that more intense prospecting and exploration throughout Canada will reveal the existence of deposits as yet unsuspected.

American Blast Furnace Research

In order to determine the feasibility of operating a furnace on 100 per cent. Cuyuna Range manganiferous iron ores and to ascertain the tonnage, fuel consumption, and recovery of manganese in commercial operation, the U.S. Bureau of Mines has maintained an experimental blast furnace at its Minneapolis Experiment Station in continuous operation for 34 days. It is considered that this test makes distinct progress on the problem of utilising manganiferous iron ores and constitutes substantial proof of the usefulness of an experimental blast furnace in the field of industrial research. 134 tons of metal were made during the test, the manganese content of the metal varying from a few per cent. to about 15 per cent. The phosphorus is high in all cases and will probably average 0·6 per cent. The problem of separating the phosphorus, iron and manganese metallurigcally will be taken up by the Bureau next year. In addition to regular operating data, such as weights and analyses of materials charged, over 800 gas samples were taken from various elevations of the furnace.

The Theory of Corrosion

In a paper on "Modern Developments in Steels Resistant to Corrosion," read before the Institution of Engineering Inspection, at a meeting held on November 13 in London, Mr. W. H. Hatfield, D.Met., said that in order to explain the corrosion of ordinary steels, several theories have been put forward—the acid theory, electrolytic theory, colloidal theories and the passive film theory. The acid theory, which is the original one, postulates that before corrosion can take place some acid must be present when the reaction ensuing is one explainable in ordinary chemical terms. In support of this we have the commonly observed rapid corrosion and dissolution of commercial iron in all mineral acids, especially when diluted, and the fact that ordinary corrosion is very much accelerated by the presence of quantities of carbon dioxide dissolved in water. A point also affording a negative support to this theory is found in the fact that alkalis have an inhibiting action. Two weak points are: (1) The purer a metal is made the less is its solubility (generally) in acids; (2) corrosion will take place in solutions which contain no free acid, and which may, in fact, have an alkaline reaction. Hence the theory has been modified to state that acid, in some form or other—*i.e.*, free or combined—must be present before corrosion can take place. Friend, in support of this theory, points out that water, from which all traces of impurity, including carbon dioxide—*i.e.*, all acid constituents—have been removed, has absolutely no corrosive action on iron, and argues that, *ipso facto*, some acid must be present. Such facts, however, are equally explained by the electrolytic theory, which, as its name implies, suggests that corrosion is due to electrolytic action caused by differences of potential between the various constituents and portions of the steel and the corroding medium and to the consequent formation of local electric currents. Without discussing further the various theories that have been advanced, the author observed that modern thought seems to combine the best portions of these theories with the old electrolytic theory.

The Modern Conception

Investigators with previously widely divergent views (including Evans, Friend, Bengough, Vernon and Wilson) are now more or less in agreement as to the mechanism of corrosive action. The modern conception may be stated briefly as follows:—Rapid oxidation may take place over the whole surface of the metal and a very thin film of oxide is formed. The nature of this film really determines the nature of the subsequent chemical action, thus: if the film thickens gradually, then there will be slow general attack; if the film undergoes local or physical changes, so that oxygen concentration cells are formed, there will be rapid local attack; if loose corrosion products or foreign substances settle on the film there will be moderate local action; if the film be eroded by fluids or solids or both, forming metal-ion concentration cells, there will be rapid action; if the film loses its adhesive powers owing to chemical changes (*e.g.*, by CO_2, H_2S, etc.) there will be increased general and local action; if the film is either not formed or is immediately dissolved by acids, there will be rapid general chemical attack.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

We are now entering upon the last month of the year and we can still see no very definite signs of the long expected and much talked about improvement in the iron and steel trade. We can say that trade is no worse than it has been during the past few months; if anything, there is just a little more business passing and in some sections of the trade prices are firmer. It must not be forgotten, however, that we have reached a very low level and it will need a material improvement to lift the trade on to anything like an economical basis.

This past month has seen some dismal indications of the depression through which the steel trade is passing. Bolckow, Vaughan and Co.'s report for the year ended June 30, 1925, is not pleasant reading. A heavy loss has been made on the year's working and another large dig into the reserve has had to be made to meet it. That process cannot go on indefinitely; and unfortunately there is not much prospect of a betterment of the position, with the steel trade in its present condition. The Consett Iron Co. announce that the results of the half year to September 30 do not warrant any interim dividend on the preference or the ordinary shares. If anyone can make a profit out of steel manufacture it ought to be the Consett Co. with their modern plant and with the privileges they enjoy in having their own raw materials from start to finish. John Brown and Co. now announce that the continued unsatisfactory condition of the steel, coal and shipbuilding trades makes it inexpedient to pay an interim dividend on the ordinary shares. It is true that in one or two instances there have been reports showing a profit, but there are special circumstances to account for this, and it is safe to say that the great majority of the steel works in this country are struggling to make ends meet and not usually succeeding.

Reaction from War Conditions

One of the chief reasons is, as we have pointed out previously, that there is too much productive capacity for the amount of work available. For the past few years the story of the steel trade has been one of fierce competition, not merely against the outsider, but by the home works against each other, sometimes approaching almost to a state of internecine struggle. Two direct results of the European War are reduced demand and increased productive capacity, and the two do not fit together. We are willing to admit that in a boom time there may be plenty of orders to keep all the works fully employed, but no undertaking can expect to prosper which spreads itself to such an extent that boom times are necessary to keep it busy. It is the steady, regular trade, bringing full or nearly full employment, which makes a firm prosperous, and that is just the condition which is lacking to-day. Each works is on the hunt for orders, and the only way of getting them in any volume seems to be by quoting a lower price than anyone else. The consequence is that we are faced with continually falling prices and yet the majority of the works are only partially in operation.

The intention of some of the leading manufacturers, expressed not only in words but in actions, is to keep the mills running, to get orders regardless of the price. For a long time the cry has been "output," in the belief that by keeping the mills fully employed the costs will be reduced to meet the low prices that have to be taken to secure the orders. That is the attitude, but it is based on a half truth. Up to a certain point it does follow that an increase in the output obtained by reducing prices does mean a reduction in the loss, but beyond that point every ton of increase obtained in this way means a greater loss. That critical point has been reached and passed by more than one firm, and some have been wise enough to see the folly of it and have fallen out of the futile scramble. Others are using up their resources in the pursuit of this policy of getting orders. The pity of it is that they are spoiling the market. A specially reduced price to secure an individual order very soon becomes the ruling market price, which in turn yields to further persuasion. This process has been going on, at any rate in plates, during the whole of the year. A little over a year ago the official price for plates was £9 15s., although this was being underquoted by 10s. Now plates are being sold at £7 5s. We know that there is some foreign competition to be met, but that is not the chief reason for this excessive reduction. The internal competition among the British works is to blame for it.

Dearer Raw Materials

To make matters worse, just at this time when the price has reached the lowest level it has touched since pre-war days, the cost of raw materials is advancing. Scrap which a month or two ago could be bought freely at 60s. cannot now be purchased in any quantity at less than 65s., and the dealers are talking confidently of 67s. 6d. before the end of the year. Coal and coke are certainly firmer than they were a few months ago, and other raw materials are following suit. This problem of increased costs and reduced selling prices is causing anxiety in many quarters. There is one other harmful result of these continued reductions, particularly in the price of plates. To a considerable extent the wages in the steel works are based on the selling price of plates ascertained over a definite period, and each fall in the average selling prices means a reduction in wages. The manner in which these reductions are being brought about is not unknown to the men, and it is not likely to encourage the good relations which are more than ever necessary at present between the employers and the men.

If there were a spirit of co-operation among the various works it might help matters, but we can see very little of it. Each works is fighting its own battle without regard to the troubles of any other works, and it is a struggle in which the fittest will survive. The spirit actuating the steel makers in this country is not such as to warrant any faith in associations for maintaining prices. Actual experience has proved that. For the same reason we are doubtful whether any scheme for the pooling of orders would be effective. At the moment there appears to be no alternative to a continuance on the present lines, until either there is a sufficient revival in trade to relieve the situation or some of the works throw up the sponge and drop out of the fight.

Pig Iron Firmer

The pig iron market shows signs of firmness. The advance in prices has been very slight, but there is no expectation of any further fall; and in view of the probable increase in the price of coke, pig iron consumers are fearing an advance in price. Consequently there has been rather a large amount of buying and makers' stocks have been considerably reduced. There has been an improved demand for hematite iron, which has made it necessary to put more furnaces into operation. Prices have stiffened and are a shilling or two above the lowest level which they had reached recently. Quotations are firm, and makers do not seem inclined to shade them.

There is nothing better to report about the finished iron trade. The works are badly in want of orders and even the marked bar makers are not busy. It seems impossible for the ironworks to compete with the continental competition, particularly that from Belgium.

Finished steel is very slightly better, as far as demand goes, but prices get worse. We have already referred to the low prices for plates, prices which must be not less than 20s. below cost. Boiler plates have been reduced 10s. per ton during the month, notwithstanding the fact that hematite is firmer. The reduction has already been discounted in the quotations made by most makers. Sections are keeping pace with the other classes of steel, and although the nominal price is round £7 per ton, orders are being taken at as low as £6 12s. 6d. Billets vary in price, but £6 5s. to £6 15s. cover all the ordinary business. Steel bars are still a good market, but the price of these has also fallen as a result of the keen competition that is rampant.

The production figures for October are a little better, but not much. The pig iron output was 473,700 tons compared with 448,700 tons in September and 586,400 tons in October last year. There were seven more furnaces in blast at the end of the month than at the beginning. The output of steel ingots and castings was 647,100 tons compared with 640,100 tons in September and 678,500 tons in October last year.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Tin Alloys

ACCORDING to an invention by the firm of J. Neurath, of Vienna, a tin-lead alloy is refined electrolytically in an electrolyte containing SO_4 ions in such quantity that the concentration of lead ions is reduced, and cathodic separation of lead prevented. Other metals may be present in the alloy, or as salts in the electrolyte, *e.g.*, copper and antimony. The proportions of these deposited are controlled by adding ammonium salts. The tin content of the deposit may be raised above 99·6 per cent. See Patent Application No. 240,147, having the International Convention date, September 19, 1924.

Reducing Oolitic Ores

A PROCESS for reducing oolitic, etc., ores comprises treating the ore with the usual additions by mechanically conveying it through a reduction furnace while it is exposed to the reducing gases from the smelting furnace. The operation of the conveyor and the working of the smelting furnace are regulated so that the reduction takes place below the sintering temperature of the ore. See Patent Application No. 240,165, by P. Gredt, of Luxemburg, having the International Convention date, September 16, 1924.

Treating Ores, Concentrates and Metallurgical Products

A PATENT has been obtained by H. T. Durant, of Crawley, Sussex, and P. W. Rhodes, of London, for a process of treating metalliferous materials containing sulphur as sulphides, in which the material is oxidised by a solution containing chromic acid. The resulting solution is electrolysed to recover the metals, and the oxidising agent is regenerated at the same time. The process is applicable for treating ores, concentrates, etc., containing copper, zinc, and lead. See Patent No. 240,888, dated May 8, 1924.

Concentration of Ores

IN the froth flotation process for concentrating ores, it is known that the floating of certain sulphide constituents relatively to others can be modified by the use of potassium cyanide, and it has now been found that this effect can be greatly improved by grinding the ore in a thick aqueous pulp which contains the cyanide. The pulp may then be diluted, and mixed with a gangue modifying agent such as sodium silicate, and with frothing agents. The residues are separated after flotation, diluted with water, and again subjected to flotation with or without the addition of an alkaline bichromate or copper sulphate. Zinc blende, previously prevented from floating, is thus recovered. See Patent No. 240,929 (H. Lavers and Minerals Separation, Ltd., of London), dated, July 12, 1924.

Iron Alloys

A PATENT application has been made by H. G. Flodin, of Raslags, Sweden, and E. G. T. Gustafsson, of Stockholm, for a process for producing iron alloys, *e.g.*, with chromium, directly from oxide ores using carbonaceous reducing agents. A charge of each of the ores with its proper amount of reducing agent is made, and is finely divided and briquetted, separate briquettes being made of the different ores or they may be mixed before briquetting. The briquettes may be melted together or separately. The briquettes may contain the necessary amount of carbon to produce an alloy containing a given carbon content. Deoxidation of the alloy is obtained by adding briquettes containing manganese ore and a reducing agent. See Patent Application No. 240,473, having the International Convention date, September 24, 1924.

Copper and Nickel

IN a patent application by International Nickel Co., of New York, for separating nickel and copper from mattes, the material is smelted in a cupola furnace with an alkali sulphide, and molten sulphides are taken from the fore hearth to a separating furnace. The bottoms are re-smelted and the copper tops resulting therefrom returned to the first smelting cupola. The nickel bottoms are treated in a converter lined with basic or neutral material yielding metallic nickel, which may be refined electrolytically. See Patent Application No. 240,789, having the International Convention date, September 30, 1924.

Zirconium Alloys

A PROCESS of preparing zirconium alloys of reduced silicon content has been patented by Electro Metallurgical Co., of New York. The zirconium compound is reduced with a carbonaceous reducing agent, and a quantity of silicon is liberated simultaneously in the same charge, so that a low-carbon alloy containing more silicon than zirconium is obtained. It is found that a low iron content facilitates the subsequent removal of silicon, which is effected by treating the alloy with an alkaline solvent for silicon such as a solution of a hydroxide or carbonate of an alkali metal or a hydroxide of an alkaline earth metal. The enriched zirconium alloy may be added to a steel bath. See Patent No. 241,844, dated July 7, 1925.

Further Notes on Flotation Processes

By A. W. Fahrenwald, U.S. Bureau of Mines

ALTHOUGH the advantages of gravity and flotation concentration are well known, there are certain types of ore with which gravity concentration cannot cope, such as ores that require fine grinding to unlock the ore minerals from each other and from gangue minerals. The unattractiveness of using gravity methods in conjunction with flotation in the treatment of such ores is sometimes due to the lack of a plentiful supply of water, an all-flotation plant requiring less water than a gravity-and-flotation plant, but more often is due to the complications that arise through such a combination. For example, in present practice the use of hydraulic classifiers and tables results in diluting the product so much that thickening is required ahead of flotation. Besides, it is convenient to add the oils and chemicals, required in the flotation treatment, to the ball mill with the original feed. This is a very suitable means of bringing about a thorough incorporation of the ingredients with the ore, but cannot be done if tables are used ahead of flotation. Flotation is now invariably a step in all ore treatment schemes, regardless of the simplicity or complexity of the ore. An appreciable percentage of the total mill feed is always so finely pulverised in the various passages through the grinding equipment that it cannot be recovered by gravity methods of concentration. This, however, is not a justification for permitting excessive pulverisation of gangue and ore minerals to take place.

Granular Products

It is stated by many who have had experience in flotation testing that there is difficulty in floating granular products free of fines. It is quite likely that this difficulty could be overcome by the use of such material as cement, a substance that seems to have considerable value as flotation agent. It is observed that minerals of the ordinary sulphides met with in practice tend to float roughly in the order of their specific gravities. In a truly hindered, settled, classified product the relative size of particles would be in the proper order to favour flotation. The heaviest particles would be the smallest; the small heavy particles would thus possess greater ratio of surface to weight than the large light particles.

On a classified feed the flotation conditions could be better controlled than on a mixed sand and slime feed. Those who have tried differential flotation on classified feed know how much easier it is to get good results than when working on the direct feed. All of the uncontrollable factors have been eliminated, and the effects obtained in testing are those due to the reagents added. This is not true of the direct feed. In the treatment of classified products one would have the advantage of being able to return coarse flotation tailing (middling) back to the ball mill for further grinding. Where large tonnages are to be handled such a scheme may be too complicated to be attractive, although there is no reason why better classification in closed circuit with grinding mills should not be done. Greater efficiency in fine grinding will quite likely come as a result of better classification rather than through a modification of the design of the fine grinding mill. If " all-flotation " has come to stay, better classification in closed circuit with the fine grinding mills must become all the more significant.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—A contribution to the study of ferro-nickel alloys. Part III. M. Peschard. *Rev. Métallurgie*, October, 1925, pp. 663–685 (in French). A thermo-magnetic investigation of these alloys.

Special nickel brasses. O. Smalley. *Metal. Ind. (Lond.)*; Part I, October 30, 1925, pp. 408–410; Part II, November 6, 1925, pp. 431–434. An investigation of the useful properties of simple and complex nickel brasses for foundry and forging work.

ALUMINIUM.—The behaviour of non-homogeneous aluminium castings on cold rolling. Part IV. E. Seidl and E. Schiebold. *Z. Metallkunde*, November, 1925, pp. 365–368 (in German).

ANALYSIS.—The complete analysis of brass. Part III. Iron, aluminium, zinc, nickel and cobalt. *Metal Ind. (Lond.)*, November 6, 1925, pp. 427–428.

COPPER.—Investigation of the influence of continued smelting in a flame refining furnace on the impurities and properties of copper. W. Heckmann. *Metall. u. Erz*, November (1), 1925, pp. 527–546 (in German).

CORROSION.—Corrosion resistance of chromium-plated steel. A. E. Ollard. *Metal Ind. (N. York)*, November, 1925, pp. 454–456. Comparative tests with deposits of other metals and composite deposits.

The protective value of nickel plating. C. T. Thomas and W. Blum. *Brass World*, October, 1925, pp. 344–349. Demonstrates the necessity for a thick deposit.

ELECTRO-METALLURGY.—Recent progress in electro-chemistry and electro-metallurgy. L. Andrieux and R. Flusin. *La Technique Moderne*, November 1, 1925, pp. 693–705 (in French).

The thermal balance-sheet and the efficiency of the electric furnace. A. Coutagne. *La Technique Moderne*. Part I, September 15, 1925, pp. 545–551; Part II, November 15, 1925, pp. 731–739 (in French). A comparison with other siderurgical apparatus.

GENERAL.—Pyrometry. Part I. J. L. Haughton. *Metallurgist*, November 27, 1925, pp. 162–165. A description of modern platinum-resistance and thermo-electric pyrometers.

New X-ray studies of the ultimate structures of commercial metals. G. L. Clark, E. W. Brugmann and S. D. Heath. *J. Ind. Eng. Chem.*, November, 1925, pp. 1142–1146. Application of these rays for the identification of working and heat-treating processes in metals.

IRON AND STEEL.—The development of pig iron production within the last ten years from the technical and chemico-metallurgical point of view. K. Hofmann. *Z. angew. Chem.*, Part I, November 19, 1925, pp. 1058–1064; Part II, November 26, 1925, pp. 1085–1088 (in German). An account of recent work with blast furnaces and electric furnaces.

Retained austenite—a contribution to the metallurgy of magnetism. J. A. Mathews. *Trans. Amer. Soc. Steel Treating*, November, 1925, pp. 565–588. Discusses the development of permanent magnet steels, as well as methods of hardening and testing them.

The use of a blast enriched with oxygen in the Thomas process. J. Haag. *Stahl u. Eisen*, November 12, 1925, pp. 1873–1878 (in German).

Modern case-hardening practice. Part I. F. M. Rowe. *Automobile Engineer*, November, 1925, pp. 426–428. Describes the selection and use of materials.

Graphite in cast iron. Part II. *Metal Ind. (Lond.)*, November 27, 1925, pp. 511–513.

NICKEL.—The electrolytic production of nickel. A. N. Campbell. *Metallurgist*, November 27, 1925, pp. 167–168. A discussion of the main problems of nickel deposition.

TIN.—The treatment of metal residues and scrap. Part II. The treatment of tin residues. E. R. Thews. *Metal. Ind. (Lond.)*, November 13, 1925, pp. 453–455. Describes the reverberatory furnace method of tin recovery, giving details of the furnace design.

TESTING METALS.—Comparative slow bend and impact notched bar tests on some metals. S. N. Petrenko. *Trans. Amer. Soc. Steel Treating*, November, 1925, pp. 519–564.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd.—Registered October 30, £500 debentures part of £10,000; general charge. *£3,859. July 24, 1924.

IRONFOUNDERS, LTD., Wakefield.—Registered November 3, £5,000 debentures, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge.

MIDDLESBROUGH STEEL TUBE AND CONDUIT CO., LTD.—Registered October 27, £2,000 debentures (secured by trust deed dated October 17, 1925); present issue £1,300; charged on property in Lower Commercial Street, Middlesbrough, also general charge. *£3,000. December 29. 1924.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield.—Registered November 6, £20,150 debentures, part of £750,000; general charge (except uncalled capital, etc.). *£500,000. October 13, 1924.

Satisfaction

LILLESHALL CO., LTD., Shifnal, coal and ironmasters. Satisfaction registered October 27, £100,000, registered October 18, 1919.

Obituary

THE death is announced at Ellesmere, Shropshire, of Mr. W. H. Carder, of Tipton, who had long been associated with the iron and steel industries. He was secretary of the South Staffordshire Iron and Steel Works Managers when there arose the demand for a closer association between the practical and theoretical sides of the industry, and it was largely due to his organisation that the Institute, now known as the Staffordshire Iron and Steel Institute, became so influential. Mr. Carder was a director of the South Staffordshire Mond Gas Co., with which he was associated from the earliest days of the introduction of gas into the Black Country.

Mr. Isaac E. Lester, whose death took place at Edgbaston, on November 27, was at one time president of the Birmingham Metallurgical Society and the Staffordshire Iron and Steel Institute. After a period of training at the Midland Institute, Birmingham, and the Royal School of Mines, London, Mr. Lester specialised on foundry work, eventually becoming foundry manager to Kynochs, Ltd., making the first castings for the large shells made at Witton. This year he went to India to start a foundry for the East Indian Railway Co., and for the past 17 years held the position of manager for Charles Akrill and Co., ironfounders, of West Bromwich.

Modern Progress in Electrodeposition

FOLLOWING our announcement last month of the proposed formation of an Electroplaters' and Depositors' Technical Society, the inaugural meeting was held on November 11. Mr. W. E. Harris, of 193, Eversleigh Road, Battersea, S.W.11, was elected honorary secretary. The first general meeting of the Society will be held at the Northampton Polytechnic Institute at 8 p.m. on Wednesday next, December 9, when a paper on "Electrodeposition: A Survey of Modern Progress" will be read by Mr. S. Field. Professor F. G. Donnan, F.R.S., president of the Faraday Society, will take the chair.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

The Ideal Association

SINCE attention has been focussed upon the serious situation produced by the unrestricted price-cutting of medium and common China Clays in the China Clay trade, the question as to how best to counteract its effect has been very widely discussed in China Clay circles during the past month. It is now generally recognised, even by those producers who were disposed to kick over the traces of the old Association, that in such a period of over-production as that through which the China Clay industry is passing, some kind of organisation is necessary to protect the interests of the industry against buyers who are taking advantage of this fact by depressing prices below a fairly remunerative level. As to how this can best be done is a problem to which several of the producers are applying their minds with a view to seeing whether some common basis of agreement can be found on which to base negotiations for a new organisation. The discussions are proceeding along four definite and fairly well-defined lines, each of which is commanding a certain measure of support. The one which it is considered would be the most successful in restoring past prosperity is what is known as a capitalisation scheme, which, briefly, involves all the China Clay works being valued and acquired on a fair basis, and embraced in one organisation which would control and work the industry as a whole, instead of, as at present, by separate firms.

Various methods of carrying out the idea have been suggested, one being that the value should be arrived at on the basis of the figure at which the China Clay from a given works can be placed free on board, and the margin of profit it would yield if sold at normal prices. Another basis of valuation suggested is the average profits earned over a period of three years. Other methods suggested are that valuation should be either dry capacity or production capacity. An important factor in the success of such a scheme would be the inclusion of the royalty owners, whose co-operation would be necessary to prevent the development of deposits by people outside the scheme.

The second kind of organisation suggested is the maintenance of the separate existence of the present producers in an organisation, an essential feature of which would be the setting up of a central selling agency, through which all producers would sell their clays at prices fixed by the industry ; buyers would then secure their supplies through this agency instead of from the producers direct.

The third suggestion has been the application of the Stevenson Rubber restriction scheme to the China Clay industry, under which outputs would be controlled so that individual firms would receive their due proportion of sales, according to the state of the market. Features of the Stevenson scheme are that it does not fix prices, and has legislative authority to see that the provisions of the scheme are observed by the producers. Further, the scheme provides for the selling of the product of the various producers through brokers.

The fourth method, which finds considerable favour, is that which governed the old Association which was broken up last year, and which, it is agreed, would never have failed if all the producers had been actuated by a desire to safeguard the interests of the industry as a whole. Its weakness was that firms who remained outside were continually encroaching upon markets by undercutting the Association's prices.

Capitalisation Scheme Favoured

It is generally agreed that a capitalisation scheme for the industry is the ideal method of overcoming present and future difficulties, but such a scheme is, however, not immediately practicable on account of the difficulties, inherent in the trade, of arriving at a reasonable common basis of valuation. This valuation must be acceptable to the various producers, and keep the capital of the company within sufficiently limited bounds to ensure a fair return for investors. If a capitalisation scheme could be brought about within these limits, there is very little difference of opinion as to its ultimate conspicuous success. As to the second method, that of a central selling agency, while favoured by many, it is felt that it would involve the severing of the direct connection of producers with their customers, which they would not be disposed to entertain unless, once established, the central agency became a permanent organisation in connection with the industry. An essential feature of a selling agency, it is agreed, would be the handing over of its control to an independent firm of accountants who alone would be responsible for the registration, invoicing, and execution of orders. This method would also involve the elimination of all but well-established middlemen whose *bona fides* and credentials were above reproach.

The Stevenson scheme possesses some favourable features that might be applied to the China Clay industry. It is thought, however, that the likelihood of obtaining legislative sanction to make it compulsory upon the China Clay producers, is too remote to be entertained. In any case, the omission of the fixing of prices, and the restriction of sales through brokers would have to be modified in its application to the China Clay industry. An organisation based on the old Association is felt to be the best method of improving the situation, because it has been found to be the most practicable and would have worked quite successfully had all the producers recognised its basic principle of *pro rata* treatment to all producers on a capacity basis.

The First Move

There are two essentials which apply equally to each of the suggested methods, if success is to be achieved—unanimity among producers, and their subsequent loyalty. We have had the opportunity of ascertaining what would be the attitude of the present China Clay Producers, Ltd., embracing the biggest firms who at present control the bulk of the best clays, in which there is limited competition. We understand that they are not disposed to take the initial steps in bringing about preliminary conversations on the subject, but they would not be averse to receiving a deputation and hearing its views, provided they were in a position to speak for a large body of producers. If the producers are actuated by a spirit of give-and-take and approach the subject in a business-like and friendly spirit, there is no reason why something should not be done to save the industry from the present ruinous price-cutting which is causing such a severe drain upon the resources of many firms.

China Clay Producers Must Co-operate

From time to time, since the dissolution of the old Association, producers have pronounced the immediate necessity for some similar fusion of interests to safeguard the industry. Now the chairman of Cornish Kaolin, Ltd., points to the "folly of continuing under conditions so adverse as the present."

PRESIDING at the ordinary general meeting of Cornish Kaolin, Ltd, on July 8, Mr. H. Montague Rogers (chairman of the company) said that it was the fifth year since the reconstitution of the company, and the first occasion that he had been privileged to address them since he succeeded Mr. C. A. Moreing.

The trading account for the year under review disclosed a profit of £1,645 7s. 7d., but the profit and loss account showed a loss of £1,258 9s. 4d. carried to the balance sheet. This included an item of £902 2s. 8d. for interest in the new debenture issue, which accounted for nearly the whole adverse balance. In comparing the items on the balance sheet with those for the year previous, the chairman said that they would find considerable variance in consequence of the acquisition of the Halviggan China Clay Works. The property and construction account stood at £121,204 16s. 4d., compared with £78,746 1s. 8d.; the machinery, plant, and vehicles at £16,971 13s. 5d., compared with £9,694 6s. 1d.; the stocks and stores on hand at £10,482 10s. 11d., compared with £6,320 9s. 7d.; the sundry debtors at £10,350 0s. 6d., compared with £5,255 9s. 8d. The other items on the credit side were practically the same as the previous year. On the debit side of the balance sheet the authorised and issued capital remained the same as before, but there had been an issue of £48,000 debenture stock to pay for the Halviggan property, to which must be added accrued interest due thereon. The item for bills payable was in respect of the China Clay stocks acquired with the Halviggan works. There was an increase in the sundry trade creditors of £738 14s., and the bank overdraft had also been increased consequent on the abnormal conditions of the China Clay industry during the year under review and the large stocks in hand unsold.

They were disappointed in their anticipations of an increased turnover during the past year, instead of which they had been confronted with market conditions entirely at variance with those of previous years. As they knew, the company was a member of the Associated China Clays, Ltd., and remained so until the Association was disbanded in September last. Since that date the market had been one in which producers had been almost wholly at the mercy of buyers, whose efforts, without any formal organisation, must lead to conditions which were not only uneconomical, but which in many cases must be disastrous. That phase of competition was particularly keen in "common" clays, and it was long evident that the only wise insurance against that contingency lay in securing control of a good and ample supply of "best" clay, the price of which had continued, and should continue, firm.

Halviggan Property

After some negotiation they were successful in purchasing the Halviggan pit and works, which were very favourably situated in the St. Austell district, and were capable of a large output of "best" clay with an established reputation. That purchase enabled them now to produce all grades of clay, and to adjust their works policy as circumstances demanded. They had for the time being restricted their output of "common" clay, and proposed following that policy as long as the present uneconomical market conditions persisted.

That voluntary restriction of output to some extent eased supplies, but was aimed mainly at the efforts of merchants and buyers further to reduce prices. At the same time it conserved their reserves of clay, and they saw no reason why, with the present firm market for "best" clays, they could not operate profitably in that section of the market, and confidently awaited the time when the present intense pressure on "common" clays must inevitably lead to lessened supplies and better prices, or, alternatively, producers as a whole take steps to prevent undue cutting of prices and place prices on a basis which will permit of a reasonable return to capital and labour.

For some time he had the honour and pleasure of being a member of the board of the Associated China Clays, Ltd., and in that capacity he had the opportunity of observing the working of that body, and learning at first hand the difficulties which centred largely round the disposal of common clays, and the competition from outside producers, who benefited very largely by the associated efforts to maintain living prices, yet by slightly undercutting these secured much of that trade. That, as all acquainted with the trade fully realised, was a matter which did not permit of an easy solution, yet he felt that the combined wisdom of producers should be able to evolve machinery capable of dealing with that problem.

He read with very much interest the remarks of Mr. R. Martin at the general meeting of English China Clays, Ltd., in April last, to the effect that one could only hope that material considerations, backed up by facts, would prove that only by pulling together, and by complete union, could the trade hope to improve its position. Attention had quite recently again been focussed on that point by Mr. C. A. Moreing in his annual address to the Sons of Gwalia, Ltd., a mining company largely interested in China Clay.

Views on New Organisation

Following the publication of Mr. Moreing's statement, several interesting contributions had appeared in the press, and it seemed to him that the consensus of opinion pointed strongly to several conclusions with which all producers, large and small alike, were agreed, namely, that only by combination could the trade hope to improve its position, and that such combination must act defensively in the interests of capital and labour, by the regulation of output and prices to prevent combination on the part of buyers acting injuriously to the trade. That the old Association, though by no means perfect, did seriously endeavour to do, and with its imperfection it was far superior to the present state of chaos. And from those conclusions appeared to emerge the suggestion that the time was now ripe, or over-ripe, for a careful and considered review of the position. Here the solid co-operation of practically all the producers was the only starting-point, and that could be only secured if producers were satisfied that their interests, large and small, were provided for.

That could be done without serious difficulty as regards "best" clays, though not so easily with "medium," and by far the greatest difficulty arose with "common" clays. Apart from such suggested improvements as affected method of rating of producers' works, the pricing of clays, the checking of producers' records, and other matters which tended to establish the fullest confidence that those difficulties could be very largely overcome, he hoped that his remarks would not only serve to indicate his views on that matter of such moment, but might form a helpful contribution at an opportune moment. The difficulties of the past were not insurmountable, and he was satisfied that producers had more than enough evidence as to the folly of continuing under conditions so adverse as the present.

In seconding the adoption of the report, Capt. A. H. Moreing, M.P., fully endorsed the views put forward by the Chairman, and also the views expressed by Mr. C. A. Moreing at the annual meeting of the Sons of Gwalia, Ltd. In his (Capt. Moreing's) opinion the reconstitution of an association was essential in the best interests of the trade, and he was convinced that, given the goodwill of all parties concerned, a scheme could be formulated which would operate satisfactorily and which would be the means of restoring prosperity to the China Clay industry. He was glad to say that there was a general opinion in the trade that some step of that kind should be taken, and he could assure everyone that that company would do all it could to bring about that much-desired result.

China Clay Merchant's Will

MR. JAMES PERRY, of Penvale, St. Austell, China Clay merchant, left £20,423, with net personalty £15,885. The will is proved by his children, Sydney Beecher Perry, Archibald James Perry, and Emily Maud Lodge, all of St. Austell. He gives £200, and, during widowhood, £165 a year to his wife, £200 to his son Archibald James, £100 in trust for his sister, Margaret Archer. Other bequests include: £100 to St. Austell Cottage Hospital, and £50 to St. Austell Nursing Association. The residue is left between his three children.

Alumina from China Clay

What Experiments Reveal

ALTHOUGH the progress so far made in experiments for producing alumina from China Clay has been small, chemical experts continue to pursue their investigations, and may eventually achieve results that may warrant development on a commercial scale. A recent attempt is disclosed in a report issued by the United States Bureau of Mines, which contains a description of Paul Miguet's proposed process for extracting alumina from clay, and an account of tests made for the Bureau by C. E. Williams and C. E. Simms.

Mr. Miguet proposes to prepare alkaline aluminate by fusing clay, lime, and scrap iron with a reducing agent in the electric furnace, thereby reducing the silica and forming calcium aluminate and ferro-silicon. The calcium aluminate, being lighter, would float on top substantially free from foreign oxides. It could then be tapped off, cooled, and later crushed and leached with sodium carbonate solution to form, by double decomposition, sodium aluminate and calcium carbonate. The former is soluble and yields readily aluminium hydroxide. The ferro-silicon would be recovered as such and sold at a profit. The reactions are thought to be as follows :—

(1) $Al_2O_3 \cdot 2SiO2 \cdot 2H_2O+Fe+4C+CaO= FeSi_2+4CO+CaO \cdot Al_2O_3+2H_2O.$

(2) $CaO \cdot Al_2O_3+Na_2CO_3=CaCO_3+Na_2O. \quad Al_2O_3.$

Production by Fusion

So many reactions similar to the above have been proposed, and it is so popularly believed that alumina can be obtained from clay by fusion, that the North-West Experiment Station of the Bureau of Mines at Seattle undertook to investigate the Miguet process. The tests were carried out in a carbon-lined pit furnace of the Girod type, having a tap-hole to remove the fused material. Clay containing 38 per cent. alumina, pure air-slaked lime, steel turnings, and gas retort carbon were used. These materials were finely ground, intimately mixed, wetted, and dried in lumps to avoid dust. In the first tests the charges were made up with clay, lime, iron and carbon in theoretical proportions according to the Miguet patent. The charge melted down readily, and was then tapped. The analysis showed only a slight reduction of silica, and it was thought that possibly insufficient time had been allowed for reduction. The test was therefore repeated, the charge being held molten for a considerable time before tapping. No increase was noted in the amount of silica reduced. When the product was crushed and leached with a hot concentrated solution of sodium carbonate, only a trace of alumina was noted and fully as much ferrous iron was found in solution. When the proportion of lime was increased, it merely increased the melting point and gave no better product. In these first tests an effort was made to keep within the limits of commercial practicability, but having failed to obtain any favourable results, these restrictions were set aside and tests were made to determine what was technically possible. The proportion of lime, carbon, and iron to clay was increased to speed up their action on the clay, and the charge after fusion was heated to 1,800° C. and held for 30 minutes. Still results were unsatisfactory. A charge was then made up with carbon three times, and iron twice the theoretical quantity. The purpose was to subject the charge to the most intense reducing conditions possible, and silica is known to reduce more readily in the presence of iron. The charge was melted with the furnace overpowered to such an extent that dense fumes arose. The product obtained was black and stony, hard enough to scratch glass easily. On examination it was found to contain carbides of calcium, aluminium and silicon, sillimanite, and quantities of a glassy substance. The analysis showed that about 40 per cent. of the silicon had been reduced and alloyed with the iron. The product of this final fusion, when leached with sodium carbonate, gave a recovery of about 30 per cent. of the alumina. This alumina produced contained 0·6 per cent. SiO_2.

Conclusions Arrived At

The fact that alumina was actually produced gives some small basis for the claims of the patent, but the prospects of its successful applications are extremely poor. In the first place, to produce alumina by the method of the most favourable test, the cost of the material alone would be more than 300 dollars per ton as the minimum figure. Moreover, there was no proof that calcium aluminate was formed, because, with so much carbide present, it was just as likely that the sodium aluminate obtained was formed by the decomposition of aluminium carbide and its subsequent solution in the sodium carbonate. It is certain, too, that silica was not alone in being acted upon by the carbon, but that all the other oxides would be also reduced in varying degrees.

China Clay and Paper

By "Observer"

IN the early days of the clay industry as related to the paper industry, China Clay producers produced substances that they called China Clay and which they offered to paper manufacturers for use with other materials to turn out cheap paper. This so-called China Clay, however, was not pure, but a mixture of China Clay and what is called "mica," which is composed of finely divided crystalline substances found in conjunction with China Clay and decomposed granite.

The method of winning and treating China Clay remained practically unaltered for many years, owing partly to the inherent conservatism of the Cornish producer and partly to the fact that his clay had a ready market. A stream of water containing from 3 per cent. to 4 per cent. of solid matter in suspension was passed through a number of terraced channels or troughs in such a way that the speed of the stream was progressively retarded to allow the larger and heavier particles it carried to sink, while the finer grained and lighter particles of China Clay passed along with the stream. The old Cornish clay worker judged by simply observing the stream whether it was too thick and if the percentage of solid matter was too high for the separation of most of the coarser substances from the China Clay. Later on, with the development of automatic production, the quality of the clay improved somewhat, but not in direct ratio to production. To-day, not only has the amount of China Clay produced increased by leaps and bounds but the speed of production has been much accelerated. New producers have arisen, new methods have been adopted, and a new class of men has been absorbed in clay work. Therefore, a great difference is often found in the qualities of the China Clays offered for sale. Quality has in many cases been sacrificed to quantity. Careful tests have revealed as much as 12 per cent. grit, *i.e.*, crystalline matter that will not pass through a 200 mesh lawn, in ordinary China Clay offered to paper makers. In the old days the paper maker did not attach much importance to this. It meant that he had to clean his lawns often, and the waste was well nigh negligible because China Clay was cheap. Demands for paper were fairly constant and he did not worry over trifles.

Paper Makers' Requirements

The manufacturer of high quality paper who keeps a careful eye on costs will no longer accept a clay containing 12 per cent. grit that compels him to stop and clean his lawns more often than is necessary. Such a paper maker now demands a clay with not more than 3 per cent. grit and the China Clay producer who wants a regular market with the manufacturer of high quality paper must see that his clay "fills the bill." If the present methods of refining clay by lavigation and gravitation are to continue, the careful clay producer must see that the percentage of clay in suspension in his stream is below the critical limit. In other words the stream must not contain more than 2 per cent. of solid matter in suspension when passing through the refining drags ; it must travel slowly to allow those substances which are heavier than China Clay, no matter how finely divided, to sink to the bottom and not escape with the clay, and other expedients have to be adopted to ensure purity. It is very probable that the producer who gives most attention to the purity of his product will have a market with the best class of paper maker while his less careful competitor is vainly seeking orders. It has been stated that some China Clays now produced contain not more than 1·5 per cent. grit. If this is true, the producers of these clays are to be congratulated on meeting conditions that have arisen through paper makers keeping a careful eye on costs and demanding a high standard of purity in the China Clay supplied.

Fowey Pilotage Dispute

High Court Action Settled

A CASE of some importance to shipowners whose ships are employed in the China Clay carrying trade from Fowey was recently heard in the Admiralty Division of the High Court before Mr. Justice Bateson and assessors.

The action was brought by the Master of the *Guelda Rose* and other masters of coasting steamers belonging to Richard Hughes and Co., of Fowey and Liverpool, against the Fowey Harbour Commissioners and Mr. F. Collins, the Harbourmaster of Fowey, for relief by way of a declaration and injunction in respect of certain directions by the Harbourmaster which the defendants claimed they were authorised to make under Section 52 of the Docks, Harbours, and Piers Act of 1847. The question really involved was whether the plaintiffs must cease to send their vessels to Fowey unless they employed a pilot. Mr. Dunlop, K.C., and Mr. Chappell appeared for the plaintiffs, and Mr. Claughton Scott, K.C., Mr. Dumas, and Mr. Nesbitt for the defendants.

Mr. Dunlop stated that Richard Hughes and Co. were owners of about 20 coasting steam vessels. The defendants contended that they were authorised to give the directions the plaintiffs complained of under Section 52 of the Docks, Harbours and Piers Act of 1847.

Plaintiffs denied that the meanings came within the meaning of the Section, and if they did they were invalid because they were contrary to common law and the statutory rights to navigate in the harbour without employing a pilot. They said they were entitled to have the reasonable use of the harbour on payment of the dues. It would be further contended for plaintiffs that the directions were dangerous, impracticable, and oppressive; thirdly, they said it was bad because the directions applied to the plaintiffs only, and not to other persons. Evidence was given by the masters of the plaintiff company that there was no necessity for them to have a pilot on board as they were well acquainted with the harbour.

At the close of plaintiff's case Mr. Claughton Scott, K.C., submitted that no case had been made out for the relief asked for. His Lordship said he would not stop the case.

Harbour's China Clay Trade

Captain F. Collins, Master Mariner and Harbourmaster, of Fowey, stated that he had held an extra master's certificate since 1906, and had had great experience at sea of all kinds of vessels. The trade of Fowey consisted mainly of China Clay, and last year's export of this article amounted to 800,000 tons, while about 1,200 trading vessels entered the harbour. There were eight pilots at the port, and to use the harbour properly it was necessary that pilots should be employed. The number of vessels using the port at one time varied greatly, the normal number being about 25 to 30. Vessels arrived with inward freights of coal, wood, cement, manure, and general cargo, while China Clay was the main export. It was important that vessels using the harbour should know the movements of other vessels, and the practice of all vessels using the port other than those of the plaintiffs was to have a pilot. Witness said he had had occasion to complain of the way in which some of the plaintiff company's vessels made fast in the harbour, which was not in seamanlike way, and the masters of other vessels had complained to him about it. In one case the explanation given was that the anchor had dragged. Witness added that he drew up the directions which were the subject of the present action.

Pilotage Fees

Mr. James Salt, a licensed pilot for 40 years, said he had handled every kind of vessel that came into Fowey. He saw the plaintiff company's representative some time ago in regard to the pilotage rates of vessels above 450 tons, these having been raised. The plaintiffs' representative wanted him to make a flat rate to take their boats in and out of Fowey. There was a meeting of pilots, who declined to assent to the proposition, as it was contrary to the rules of Trinity House. It was quite possible for that part of Fowey Harbour above Prime Cellars to get congested.

Mr. Frederick Johns, another licensed pilot, gave similar evidence.

Mr. Samuel Archibald Buley, one of the Harbour Commissioners, gave evidence as to the directions being passed by the Board.

On the third day his Lordship suggested that the parties might agree to some modification of the directions. If he could help he would be very glad to do so. Certainly the directions might be modified without detriment to anybody if approached in a businesslike way. He then interviewed counsel. This was followed by a long discussion between the parties which practically resulted in a settlement, and the case was adjourned.

Mr. Dunlop, K.C., expressed his and his clients' thanks to his Lordship, and hoped that the result would be a scheme working satisfactorily to both parties.

The China Clay Industry

To the Editor of THE CHEMICAL AGE.

SIR,—With much interest we have read your article in the June issue of your paper on the present state of affairs in the China Clay industry in Cornwall, and in general we agree with your views that some means have to be found to place the industry on a satisfactory footing.

As matters stand now, prices of China Clay have come down from 25 per cent. to 30 per cent. since the Association broke up in September last, and no one has benefited from this except the consumers, who, in face of the existing competition, often demand the impossible from the producers.

In consequence of this state of affairs, many properties have come on the market, and we understand that many more will be offered for sale shortly. As the producers are so differently situated on account of the variety of qualities produced, it will be difficult to reach unanimity; but one thing might be done at once, i.e., to reduce by agreement the wages to the same extent as prices have fallen, viz., from 25 to 30 per cent. If all agreed to this proposal there would be no doubt that the Cornish labourer would accept these terms in order to avoid further unemployment.

Trusting that this suggestion will fall in with the views of the producers, We are, Yours, etc.,

For THE CONSOLIDATED MINES OF CORNWALL, LTD.
M. E. FRASER, Secretary.

32, Seething Lane, E.C.3.
June 22.

Esparto Pulp Paper

An Important Use for China Clay

THE construction by the Carrongrove paper-making concern—now associated with the important Scottish Inveresk Paper Co.—of the largest and most up-to-date coated paper mill in Great Britain, has directed attention to the prosperity of mills using esparto grass pulp in conjunction with China Clay.

During the period of trade depression the Scottish esparto mills seem to have had the best of the business that has been going and, whilst they have been able to show substantial profits and make considerable extensions to their works and to the plant, the mills using pure wood have, from all accounts, had a very lean time and have had a hard job to show satisfactory balance sheets. Looking at the matter from an outsider's point of view, the secret of it would appear to be largely one of foreign competition. The esparto mills make a class of paper quite distinct from anything that comes to us from either Continental, Canadian or American mills—paper which either as M.F. printing, imitation art or coated art, is eminently suited for good-class publication purposes. Their writing papers have also a distinctive character, and it is possible that half of the medium-priced writing paper used in this country comes from Scottish mills.

Qualities of Clay-coated Esparto Paper

Esparto pulp gives a paper of a peculiarly soft texture, a very clean and clear white, and bulks for its substance quite 10 per cent. more than paper made from any other material. Where hardness and strength are needed it is quite useless, but where whiteness with capacity, good finish, and folding properties are required it stands alone. The esparto pulp will take up China Clay to the extent of as much as 50 per cent. of its bulk.

China Clay Notes and News

Varcoes China Clays, Ltd.

On his return from a business trip to America on behalf of his firm, Mr. G. M. Johnstone, a director of Varcoes China Clays, Ltd., states that the competition of the domestic clays in the States is very real, though he found prospects which encouraged him to anticipate large orders for English China Clays in the near future.

Shark Visits Charlestown

The evening appearance of a bottle-nosed shark in the harbour mouth at Charlestown last month caused a good deal of excitement, and its capture, after half an hour's effort, provided much entertainment for a large crowd of spectators. To prevent its escape to the open sea, boats were placed in the mouth of the pier, the fish being driven back with the aid of oars, while inside the pier other men attempted to grapple the shark with the aid of grapplers. Eventually it was driven against the pier, where it was hooked by means of a boat-hook, and subsequently landed. It was over 8 ft. in length, and afterwards was cut up and used as bait for crab and lobster pots.

Record Shipment from Charlestown

On July 6 and 7 the largest cargo boat to enter Charlestown dock was loaded with China Clay by J. Lovering and Co. in less than 14 hours. The vessel, which was the ss. *Orenie*, of Appledore, whose captain—Captain W. Moyse, of Bideford—is a native of St. Blazey, was 550 tons register, 190 ft. long, with 25 foot beam, and a draft of 13 ft. 6 in. We understand another 550-ton boat has been booked to Charlestown with coal. The boat was chartered on behalf of Varcoes China Clays by Mr. T. A. Rowse, Charlestown. The opening up of this port to large vessels should prove of great advantage to the neighbourhood.

Grose and Stocker, Ltd.

The old-established firm of Grose and Stocker, who do a large business in China Clay, have notified their customers and business friends of the formation, for family reasons, of their business into a private limited liability company. The following is the announcement of the registration of the company :—

GROSE AND STOCKER.—June 29. £60,000 (£1). To acquire business of merchants of China Clay and other substances carried on at Stoke-on-Trent as Grose and Stocker, and to adopt an agreement with A. D. S. Stocker, F. M. Grose, and W. M. Lovatt. Life directors : A. D. S. Stocker, Stoke-on-Trent ; W. M. Lovatt, Market Drayton, director of John Hammon and Co. (1922) ; F. M. Grose. Qualification, £1,000. Private (206,926).

Fowey Harriers' Master's 42 Years

The followers of the Fowey Harriers have marked the retirement of Major J. de C. Treffry, after 42 years' mastership, by presenting to him and to Mrs. Treffry their portraits in oils. The presentation was made by the new joint Masters, Lady Vivian and Miss Ivy Martyn, at a garden party held in the grounds of Penarwyn, the residence of Major and Mrs. Treffry. Lord Vivian presided at the ceremony, when eulogistic references were made to the tactful way Mr. Treffry had led the harriers for 42 years, and regret expressed at his retirement. Mr. R. Clark, one of the veterans, said he had been a follower of the Harriers for nearly 50 years. Mr. J. Hoyle co-operated with Mr. W. Treffry in the duties of secretary in the organisation of the testimonial.

The portrait of Major Treffry depicts him in the garb of Master and is inscribed : " Presented to Mrs. J. de C. Treffry by the followers of Fowey Harriers, on the termination of her husband's 42 years' Mastership of Fowey Harriers, as a token of respect and gratitude for her many acts of kindness." The portrait of Mrs. Treffry is inscribed : " Presented to J. de C. Treffry, Esq., J.P., by followers of Fowey Harriers on the termination of his Mastership, in gratitude of the sport he has provided with his pack for 42 years, and as a mark of their esteem and affection."

St. Austell and the China Clay Industry

Following an address by Rotarian S. P. Bunn at the St. Austell Rotary Club on some drawbacks of St. Austell, in the course of which he referred to the lack of co-operation in the China Clay industry, Rotarian E. J. Hancock said that as regards the lack of co-operation in the China Clay industry, the prosperity of the town depended upon China Clay which, next to coal, was our most important raw material export industry. He regretted that while the children in the schools in Cornwall were taught the importance of other industries, they were taught very little about China Clay, and knew very little of how it was raised, what it was used for, and its potentialities. He was connected with a family who had had associations with China Clay for over 100 years, and he believed it was only yet in its infancy. They lacked an organisation for research aiming at the discovery of new uses and the bringing of the commodity to the notice of new markets. Outsiders had come in, thinking they could teach the pioneers of the industry their business, but had found that they could not, and were now complaining because they were beginning to feel the effects of the absence of an Association.

Cheap China Clay Setts

Registered in the slump year of 1921 to work a China Clay property that was favourably reported upon, Cornwall China Clays, Ltd., offered the Wheal Louisa and Hornick China Clay setts, near Lanjeth, St. Stephens, for sale last month. Mr. Rutherford D. Duff offered the property, Mr. J. Couch represented Stephens Graham Wright and Co., the solicitors for the vendor, and Mr. C. C. Cornish, secretary, represented the company.

The setts were described as comprising about 140 acres of tested and proved China Clay bearing land of excellent quality, situated in the centre of the China Clay district, and adjoining Blackpool and Halviggan works. In the Wheal Louisa section there was a pit of uncovered clay approximately five acres in extent. With adequate equipment, it was stated that the property " is capable of yielding 30,000 tons of clay per annum at a production cost of from 28s. to 30s. per ton." The lease from Mr. J. Bevil Fortesque is for a term of 40 years, dating from January, 1921, the royalties being " at the normal rate," merging in minimum rents in 1925 of £150, in 1926 of £550, in subsequent years of £800 per annum.

There was only one bid—from Mr. E. J. Hancock, of St. Austell—of £200, and as the auctioneer said the setts were being sold without reserve, they were knocked down to him for that amount. The nominal price shows the extent to which the values of China Clay setts have fallen, compared with pre-war.

Tragedy of a China Clay Worker

Dread of the Labour Exchange, following upon his discharge from employment, and despair at his inability to find work in competition with younger men, were the facts revealed at an inquest, conducted without a jury, at Whitemoor, St. Stephen's, last month, on Samuel Martyn (60), ex-china clay quarryman, who was found hanging dead from a beam in his kitchen.

Mrs. Martyn, the widow, said her husband was aged 60, was a china stone quarryman, had recently been employed by a tin-dredging company on Goss Moors, and was dismissed a fortnight ago. His sudden unemployment preyed on his mind. When she awoke at 5.30 a.m. she was surprised to find he had disappeared. Her husband did not like the idea of going on the Labour Exchange. He was due to go to the St. Austell Labour Exchange to receive his pay for the first time on the day of his death.

Thomas Boland, brother-in-law of Mrs. Martyn, said Boland had been brooding over being out of work, thinking his age was against him. He said : " What chance have I got for work against strong, healthy young men who are unemployed ? " Deceased was a man of 15 stone and the rope was not long enough to allow a drop. There was insanity in the family.

Dr. Manson, St. Dennis, said deceased's neck was not broken, the cause of death being suffocation.

The Coroner returned a verdict of suicide while of unsound mind.

Why China Clay Trade Suffers

The China Clay trade as a whole suffers from the disorganisation caused by the collapse of the Producers' Association last autumn, says *The West Briton*, the Cornwall county paper. A " price war " may suit some firms, but there would appear to be no doubt that it has had a deleterious effect on the industry at large. The question interests the whole county, for the economic consequences of prosperity or depression in this great trade are widespread throughout Cornwall. Three alternatives to the present confusion are being discussed. One is the revival of the Producers' Association with a new set of rules providing for a little more elasticity of method, an active intelligence department, watching markets, and possibly a central selling agency. Another is an attempt to establish a restriction scheme on the lines worked by the rubber trade—a difficult solution, because it would need plenary powers that could be acquired only by legislation. The third is the financial unification of the whole industry, producers and royalty owners included. English traditions and the English temperament do not lend themselves easily to the cartel system, and no great industry in the country has yet combined into an absolute monopoly, though the China Clay trade, highly concentrated in this corner of the country, offers " favourable ground " for an experiment. Whatever the outcome of the discussion, it is evident that some greater measure of understanding and co-operation among the interests concerned is needful for the health of the industry.

New Cornwall Electricity Scheme

The Electricity Commissioners have approved an important scheme, under the Trade Facilities Act, which is being undertaken by the St. Austell and District Electric Lighting and Power Co., Ltd. The scope of the undertaking includes the erection of a power station near the English China Clay Co.'s china stone mills at Pont's Mill, St. Blazey.

The ultimate object of the company is to supply practically the whole of the area over which they have exclusive powers, which includes the whole of the St. Austell China Clay district, embracing 15 parishes, and including the borough of Fowey. In the meantime it is the intention to put down a high tension system which will be capable of being extended to take in any demand there might be throughout the area. The plant to be installed in the first instance will be capable of generating up to 1,250 h.p., constituting 50 cycles of alternating current stepping up to 11,000 volts for transmission purposes. A site of several acres has been acquired with a view to putting in large units of either steam or oil plant. In its initial development it is intended to cater for half the company's present area comprising the south-east side, including St. Austell and part of St. Mewan parish, St. Blazey, Par, and Fowey. The plant to be installed immediately will consist of three oil engines of a total of 800 h.p., directly coupled to alternators. The current from the power station will be transmitted from generators at a pressure of 440 volts, which will supply through transformers up to 11,000 volts. These transformers will feed an overhead transmission line running between Fowey, St. Blazey, and St. Austell. The current at the various terminals will be reduced to the ordinary supply pressure of 220 volts, and distributed to the various districts on overhead low tension transmission lines.

The enormously increased demand in St. Austell itself has made it necessary for the company to look elsewhere for a suitable site to supply the St. Austell district, and in addition the time has come for the company to carry out its obligations in Fowey. A request has been made by the Par Harbour authorities for a supply for the Harbour, and the company has also received inquiries with regard to supplying China Clay works. The company has fixed upon the present site as the most convenient and suitable from the point of view of railway, road, and water facilities. The St. Austell Electric Lighting and Power Co., Ltd., which has been operating since 1905, has never increased its prices for light above 10d. per unit, and for power above 6d. per unit, which compares favourably with any supply in Cornwall, these rates being lower than most, and only slightly higher than some of the big London supply companies. These are the rates charged for light and power for domestic purposes, but for use for industrial purposes on a large scale, such as the China Clay works, the rates would be appreciably less according to the quantity of light and power used.

When the scheme is completed it will be the most important electrical undertaking in the county.

Fifty Years in Freemasonry

Mr. J. W. Higman, J.P., of John W. Higman and Co., has been the recipient of further recognition in connection with Freemasonry. He has been presented with a massive silver salver by the members of the St. Austell Peace and Harmony Lodge of Freemasons. The presentation was made by W. Bro. E. J. Hancock (of West Carclaze China Clay Co., Ltd.), the I.P.M., in the presence of a large gathering of the craft. The silver salver bore the inscription, " Presented to W. Bro. John Wheeler Higman, P.P.G.S.W., on the occasion of his attaining 50 years as a member of the craft, as a mark of esteem and affection by the members of the Peace and Harmony Lodge, 496."

W. Bro. E. J. Hancock said he was very grateful for the honour and the privilege of being permitted to make that presentation to W. Bro. John Wheeler Higman, as he attained his jubilee as a member of the craft in his year of office. For all of them W. Bro. Higman stood for an idea, the idea of progress and achievement. He represented to them the ladder of progression by merit, and to the youngest member joining the brethren he appeared before them as one who had advanced by just and regular steps through the various degrees of the craft and through provincial honours to Grand Lodge rank. They felt sure that for many years to come the spirit of W. Bro. J. W. Higman and what he stood for would pervade that lodge. The Brethren decided to present to W. Bro. J. W. Higman that visible and material representation of their esteem, goodwill, desires and prayers for his future peace, comfort and happiness.

W. Bro. Higman acknowledged the gift and expressed his deep appreciation of the kindness of the brethren.

Clay Convention Omission

At the clay convention recently held at Buxton, not only were workers in the Pottery Trades not represented, but there was no representation from the China Clay and ball clay trades. Though the convention concerned itself more with the heavy clay product trades, there was much of interest in it for what may be described as the finer branches of the industries in which clay is a raw material. It would be of considerable benefit to the clay trade as a whole if the scope of the convention were widened to embrace all sections of the clay industry.

Mr. HERBERT WRAGG, M.P. (President of the Institute of Clay-Workers), who presided, said that first and foremost among the various branches of the trade represented must be mentioned the refractory section, upon which the main industries of the country depended and without which, during the war, no munitions could have been produced. Secondly there was the housing section, in which manufacturers produced everything in clay products from a bath to a chimney-pot—in other words everything that was necessary for the construction of a house and much that was necessary for its decoration. Thirdly, there was the general sanitation section, in connection with which it might be interesting to state that, through the medium of the manufacturers of the heavier clay products, Great Britain had been the pioneer of sanitation throughout the world; and the fourth section represented by that convention comprised the manufacturers of electrical goods.

It was interesting to note the volume of trade done by the manufacturers represented at that first clay convention and the extent of the labour which they employed. From Board of Trade figures it was ascertained that, eliminating those men who were employed in the mining of clay, there were at least 120,000 people employed in the clay-working industries. In 1923, which was not a boom year, but rather a period of a certain amount of stagnation in some branches of the trade, it was estimated that the bricks—firebricks and ordinary common bricks—manufactured, amounted to something like 25 million tons. Of stoneware tubes for sanitation and electrical purposes something like 672,000 tons were conveyed over the British railways. On a moderate estimate he would say that the annual output of the clay trade represented at that conference was something like 36 million pounds in value.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—June, 1925

Arrival Date	Name	Sailing Date	Destination
June 1,	S.S. *Scartho*	June 5,	Sarpsborg
June 1,	S.S. *Port Said Maru*	June 13,	Portland, Me.
June 3,	M.V. *Brando*	June 6,	Oscarsham
June 3,	S.S. *Elizabetta*	June 6,	Preston
June 3,	S.S. *Ferndene*	June 9,	Pasages
June 3,	S.S. *Falmouth Castle*	June 5,	Weston Point
June 4,	S.S. *Beryl*	June 10,	Antwerp
June 5,	S.S. *Tento*	June 11,	Newfoundland
June 7,	S.S. *Monsun*	June 11,	Fredrikshald
June 7,	S.S. *Florentino*	June 11,	Genoa
June 7,	S.S. *Greta*	June 9,	Gothenborg
June 7,	*Pacquerette*	June 19,	La Pallice
June 9,	S.S. *Hartfell*	June 13,	Genoa
June 9,	*Mary Barrow*	June 19,	Rochester
June 9,	S.S. *Dorset Coast*	June 13,	Birkenhead
June 9,	*My Lady*	June 10,	Weston Point
June 10,	S.S. *Erika*	June 15,	Antwerp
June 11,	S.S. *Woolaton*	June 13,	Ridham
June 11,	M.V. *Matilda*	June 15,	Harburg
June 11,	S.S. *Ewy*	June 15,	Harburg
June 11,	M.S. *Florida Maru*	June 17,	Antwerp
June 13,	S.S. *Kamma*	June 18,	Kotka
June 13,	S.S. *Balfron*	June 16,	Boness
June 15,	S.S. *China Maru*	June 24,	Boston
June 15,	S.S. *Gouwestroom*	June 17,	Amsterdam
June 15,	S.S. *Falmouth Castle*	June 18,	Manchester
June 15,	*M. A. James*	June 26,	Harburg
June 15,	M.V. *Lwow*	June 19,	Genoa
June 17,	S.S. *System*	June 19,	Rouen
June 17,	S.S. *Eskbridge*	—	
June 17,	M.V. *Venturer*	June 22,	Gravelines
June 17,	S.S. *Marena*	June 20,	Gravesend
June 17,	M.V. *Ingeborg*	June 20,	Karlskrona
June 17,	M.V. *Ramonde Naval*	June 19,	Reval
June 19,	*Gull*	June 26,	Reval
June 19,	S.S. *Rossmore*	June 24,	Rouen
June 19,	S.S. *Terje*	June 24,	Montreal
June 19,	*Louise*	June 30,	Runcorn
June 19,	S.S. *Teesbridge*	June 27,	Portland, Me.
June 19,	S.S. *Elna*	June 25,	Portland, Me.
June 19,	S.S. *Halton*	June 23,	Liverpool
June 20,	S.S. *Baron Inchcape*	July 2,	Portland
June 20,	S.S. *Alice*	June 26,	Weston Point
June 21,	S.S. *Claretta*	June 25,	Aberdeen
June 21,	*Greenhithe*	June 24,	Chiswick
June 23,	*Sunshine*	July 1,	Rochester
June 23,	S.S. *Shoreham*	June 27,	Preston
June 24,	S.S. *Jarrix*	June 29,	Grimsby
June 24,	S.S. *Pearl*	June 27,	Harburg
June 24,	S.S. *Southwell*	June 27,	Pasages
June 24,	*Mount Blairy*	June 30,	Hull
June 25,	S.S. *Ortona*	June 29,	Hull
June 25,	S.S. *Baron Garioch*	July 2,	Portland, Me.
June 25,	S.S. *Ualan*	June 30,	Antwerp
June 25,	S.S. *Primrose*	June 27,	Bo'ness
June 25,	M.V. *Lydia Cardell*	June 30,	Rouen
June 25,	S.S. *Elvington*	July 2,	Brussels
June 26,	*Snowflake*	July 3,	Weston Point
June 27,	S.S. *Brynawel*	July 3,	Larne
June 27,	S.S. *Mayrix*	July 3,	Antwerp
June 29,	S.S. *Guelder Rose*	July 2,	Weston Point
June 30,	S.S. *Monkstone*	July 3,	Brussels
June 30,	S.S. *Falmouth Castle*	July 1,	Runcorn

Charlestown Shipping—June, 1925

Arrivals

Date.	Vessel.	From
June 5	*Treleigh*	Portreath
June 6	*Lady Belle*	Plymouth
June 6	*Loustic*	Nantes
June 6	*S. O. Pearce*	Cardiff
June 10	*Nalan*	Teignmouth
June 10	*Glenbrook*	Truro
June 15	*Valonia*	Paignton
June 16	*Scotia*	Southampton
June 17	*Millocrat*	Plymouth
June 17	*Dewadden*	Fowey
June 19	*R. Passmore*	Truro
June 21	*Hector Curdy*	Goole
June 24	*Oxbird*	Truro
June 28	*Lady Daphne*	Truro
June 29	*Jartiena*	Kotka

Sailings

Date.	Vessel.	Destination.
June 6	*Treleigh*	Preston
June 6	*The Lady Belle*	Barrow
June 10	*Glenbrook*	Sunderland
June 11	*Nalan*	Brussels
June 18	*Loustic*	Nantes
June 18	*Valonia*	London
June 18	*Scotia*	London
June 19	*Millocrat*	Barrow
June 20	*Dewadden*	Rouen
June 22	*S. O. Pearce*	Rochester
June 24	*R. Passmore*	Western Point
June 25	*Oxbird*	London

Par Harbour Shipping—June, 1925

Arrivals

Date.	Vessel.	From
June 2,	S.V. *Flying Foam*	Falmouth
June 3,	S.V. *Venta*	Salcombe
June 4,	S.S. *Poolton*	Fowey
June 6,	S.S. *Abercraig*	Goole
June 6,	S.V. *Pedestrian*	Cardiff
June 7,	M.V. *Raymond Naval*	Kotka
June 8,	M.V. *Ingeborg*	Kotka
June 9,	M.V. *Matilda*	Plymouth
June 9,	S.V. *Martinet*	Plymouth
June 9,	M.V. *Gaelic*	Plymouth
June 9,	S.S. *Tanny*	Newlyn
June 11,	M.V. *Multonian*	Chichester
June 11,	S.V. *Two Sisters*	Charlestown
June 12,	M.V. *Katie*	Torquay
June 12,	S.S. *Edith*	Fowey
June 13,	M.V. *Garlanstone*	Torpoint
June 14,	S.S. *Treleigh*	Portreath
June 17,	S.V. *Genesta*	Torquay
June 18,	S.V. *Duchess*	Falmouth
June 18,	S.V. *Guiding Star*	Falmouth
June 18,	S.V. *Lady Agnes*	Mevagissey
June 20,	S.V. *Hero*	Falmouth
June 20,	S.V. *Englishman*	Falmouth
June 23,	S.S. *Tanny*	Hayle
June 23,	S.S. *Mia*	St. Ives
June 23,	S.V. *Gwynhelen*	Plymouth
June 23,	S.V. *Triumph*	Truro
June 27,	M.V. *Garlanstone*	Poole
June 29,	S.S. *Treleigh*	Portreath
June 29,	S.S. *Teign*	Plymouth
June 30,	S.V. *Penryn*	Falmouth

Sailings

Date.	Vessel.	Destination.
June 8,	S.S. *Poolton*	Brixham
June 9,	S.V. *Flying Foam*	Runcorn
June 9,	S.V. *Martinet*	Penzance
June 10,	S.S. *Abercraig*	Newlyn
June 10,	M.V. *Matilda*	Fowey
June 12,	S.V. *Venta*	Dartford
June 12,	M.V. *Gaelic*	Glasgow
June 12,	S.S. *Tanny*	Bristol
June 12,	S.S. *Edith*	Plymouth
June 13,	M.V. *Multonian*	Plymouth
June 17,	M.V. *Raymond Naval*	Fowey
June 17,	M.V. *Ingeborg*	Fowey
June 17,	S.S. *Treleigh*	Weston Point
June 19,	S.V. *Pedestrian*	Erith
June 19,	S.V. *Two Sisters*	Antwerp
June 19,	M.V. *Garlanstone*	Poole
June 20,	S.S. *Genesta*	Queenborough
June 22,	M.V. *Katie*	Rochester
June 23,	S.V. *Duchess*	Weston Point
June 23,	S.V. *Guiding Star*	Weston Point
June 24,	S.V. *Lady Agnes*	Queenborough
June 24,	S.V. *Hero*	Weston Point
June 24,	S.S. *Tanny*	Penarth
June 24,	S.S. *Mia*	Fleetwood
June 26,	S.V. *Triumph*	Plymouth
June 27,	S.V. *Gwynhelen*	London

Par Harbour Tide Table, July, 1925

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	18	4.32	4.57	11.2
Sunday	19	5.21	5.45	11.7
Monday	20	6.7	6.25	11.11
Tuesday	21	6.44	7.3	11.6
Wednesday	22	7.22	7.39	11.6
Thursday	23	7.55	8.10	11.4
Friday	24	8.26	8.42	11.5
Saturday	25	8.58	9.16	11.4
Sunday	26	9.32	9.49	11.4
Monday	27	10.7	10.28	11.2
Tuesday	28	10.50	11.10	10.9
Wednesday	29	11.37	—	10.5
Thursday	30	0.5	0.37	10.3
Friday	31	1.15	1.51	10.6

E. CLEMENS, Harbour Haster.

June Deliveries Decline

THE recovery of deliveries in May was not fully maintained in June, though deliveries did not drop back to the low level of April. The falling-off on the month was a little over 10,000 tons. The lessened shipments from Fowey were wholly responsible for the drop, mainly due to the execution of fewer orders for China Clay. There was a slight reduction in China Stone tonnage, and an increase of nearly 800 tons in Devon ball clay. On the six months there has been a total increase in volume of all classes of trade done of over 42,000 tons, compared with the first six months of last year. China Clay was responsible for more than this amount of increase, for there was a reduction of over 2,000 tons in ball clay, and over 1,000 tons in China stone in the same period. Details :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total Tons.	
Port.	1925	1924	1925	1924	1925	1924	1925	1924
Fowey	56,019	43,775	3,004	2,930	2,619	3,076	61,642	49,781
Charlestown	3,271	3,374	—	—	—	—	3,271	3,374
Plymouth	2,950	1,729	—	20	—	—	2,950	1,749
Par	2,327	5,270	826	360	—	—	3,153	5,630
Falmouth	200	—	—	—	—	—	200	—
Newham	—	176	—	—	—	—	—	176
By Rail	4,255	4,180	—	—	—	—	4,255	4,180
Totals	69,022	58,504	3,830	3,310	2,619	3,076	75,471	64,890
May	80,860	82,405	4,286	3,363	1,825	2,589	86,971	88,357
April	59,624	75,311	3,198	4,651	1,118	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,056	3,978	3,050	1,567	80,046	62,231
6 months	445,076	399,341	19,782	21,029	11,081	13,274	475,939	433,644

China Clay Exports for June

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination, registered during the month ended June 30, 1925 :—

Country of Destination.	Quantity. Tons.	Value. £
Finland	852	738
Esthonia	303	266
Sweden	2,330	5,865
Norway	1,718	2,319
Germany	5,309	12,161
Netherlands	2,171	4,933
Java	95	360
Belgium	5,098	8,249
France	3,008	4,642
Spain	945	2,297
Italy	2,548	5,603
China	6	27
United States of America	34,258	68,385
Brazil	—	3
Argentine Republic	112	463
Channel Islands	309	248
Bombay via Other Ports	1,530	6,092
Bengal	616	2,268
Australia	22	101
Canada	132	498
Total	61,362	125,518

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BLOOMDALE CHINA CLAY CO., LTD., London, E.C. Registered June 22, £1,500 debentures, to W. E. S. Taylor, 80, Bishopsgate, E.C., director of the company and another; general charge. *Nil. June 4, 1925.

FONTLEY BRICK AND TILE CO., LTD. Registered June 9, £3,000 debenture (as additional security for amount primarily secured by a mortgage), to S. Brutton, 124, High Street, Portsmouth, solicitor; general charge (subject to £11,000 debenture). *£18,174 19s. June 26, 1924.

HICKS (MONEY) AND MILLS, LTD., London, S.W., paper manufacturers. Registered June 5, £100 and £100 debentures, part of £500; general charge. *£200. December 31, 1923.

HICKS (MONEY) AND MILLS, LTD., London, S.W., paper manufacturers. Registered June 20, £100 debentures, to Florence Durling, 54, Fetter Lane, E.C.; general charge. *£200. December 31, 1923.

WRIGHT (EDWARD) AND CO., LTD., Chesterfield, earthenware manufacturers. Registered June 18, £5,000 debentures, to H. Beard, 60, Kingfield Road, Sharrow, Sheffield, estate agent; general charge (subject to £300 mortgage). *£300. March 11, 1925.

Satisfaction

WHITELEY (B. S. AND W.), LTD., Pool, paper manufacturers. Satisfaction registered June 20, £700, part of amount registered September 16, 1924.

China Clays in Australia

AUSTRALIA has large deposits of China Clay, and a report has been prepared on their different qualities—"Australian Clays in the Manufacture of White Pottery Wares," by R. C. Callister, Bull. 27, Institute of Science and Industry, Commonwealth of Australia.

Most of the China Clay employed in the work was from Lal Lal, and it is said that in this locality "very large quantities were available of a very uniform composition; later it was proved that this uniformity was further increased" when the material from the top was not mixed with that from below, but analyses justifying these statements are not recorded. The ultimate composition is not far removed from that of some of the English China Clays. The statement that the osmose process of purification has been condemned in America may convey a wrong impression. Very elaborate and expensive trials on the process have also been made by the British Refractories Research Association. The net result showed that the expense did not justify the results obtained by this mode of purifying fireclays. Several countries have deposits of good China Clay near at hand, and yet many manufacturers prefer to import the Cornish clays, *e.g.*, Germany, the United States, etc. Manufacturers have stated that they prefer Cornish clays because (1) their uniformity can be depended upon from year to year; and (2) with other clays there are small losses in manufacture which are a constant and irritating dead-charge on the output.

China Clay Imports for June

A RETURN showing the registered imports of China Clay (including china stone) into Great Britain and Northern Ireland during the month of June, 1925, gives one consignment only—from France—totalling 10 tons, and valued at £33.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

First Six Months' Trade

If it were not for the depressing effect that the price-cutting in the China Clay industry has had upon the finances of several firms, the figures showing a substantial increase in trade during the first six months of this year would be generally welcomed. While a greatly increased volume of trade is recorded, it is not very much greater than the normal increase in the trade that was to be expected from the revival of overseas markets, and also the German market. The lowering of prices has not fostered a sufficiently enhanced volume of trade to enable the producers to receive any appreciable compensating advantage that might otherwise have accrued from establishment charges and production costs per ton. Bearing in mind these limitations, the trend of trade disclosed by the figures published on another page is distinctly interesting. The total increase for the six months on the last year's total is 35,487, of which the export trade was responsible for 12,164 tons, and the home trade for 23,323 tons. The ratio of increase was greater in the home trade than in the export trade, thus reversing the position disclosed by the figures of 1923. The lowering of prices after the break-up of the Association in September last year is seen in the lowering of the average price by 7s. 6d. compared with 1923. As best clays have, on the whole, maintained their pre-Association level, the drop on common clays being much greater than this average fall discloses. As recently there have been some suggestions that the lowering of prices has favoured the export trade more than the home trade, we would emphasise the fact that there is no differentiation in price as between home and export trade.

The Export Trade

An examination of the export figures shows that there has been no substantial increase in the deliveries to America compared with last year's half-yearly average, although the higher prices ruled for nine months of last year. A feature of the European export trade is the steady revival of the German market, the total of 14,322 tons shipped for the six months being by far the greatest since 1914. The quantity shipped for the whole year of 1924 was 19,742 tons, while in 1923 it was only 6,735 tons. During the last year, industrial and financial conditions in Germany have operated more favourably towards the English China Clay trade, and less favourably toward that of Czechoslovakia, and long, expensive railway transport militates against Czechoslovakian clays. On the other hand, we appear to have lost our direct export trade with Austria and Hungary, whose markets are more favourably situated for Czechoslovakian clays. Trade with the Scandinavian countries has been maintained at a fair level, but figures for the Netherlands are still far below the pre-war level, though well above the average for the past five years. Belgium shares with Italy the distinction of being the only European countries that have exceeded their pre-war volume. Belgium has taken in the six months 27,185 tons, and Italy 14,879 tons. France continues to lag behind her pre-war volume. Her yearly average for the past four years has been round about 36,000 tons, something like 10,000 tons below her pre-war average. Spain is substantially below last year's average, but level with her post-war average. Russia continues to be the dullest market in Europe, the quantities going to Finland, Esthonia, Latvia and North Russia totalling less than 6,000 tons for the half-year, compared with the pre-war half-yearly average of over 20,000 tons.

Expansion in Home and Colonial Markets

The colonial markets show an expansion of about 20,000 tons on the pre-war volume, and an encouraging feature is the improvement in the last two years of the Indian markets. A discouraging feature is the falling off of direct shipments to Canada. The probability is that Canada is drawing her supplies of English China Clays through American channels.

The only foreign market that shows signs of development is that of the Dutch East Indies, small though growing shipments being made to Java, the centre of the rubber industry of that country. The markets in South American States do not show any appreciable expansion. As regards new colonial markets, the prospects last year of the development of markets in South Africa have not materialised to date. Tonnage to home markets shows a substantial increase above the post-war average and reveals a gratifying expansion of about 25,000 tons on the pre-war average. The total trade for the six months this year is within 2,000 tons of the best pre-war half-year of 1912. Bearing in mind the fact that since 1914 the productive capacity of the industry has practically doubled, the problem of over-production is one that can only be met by a trade association to maintain prices at a remunerative level, in the same way as a scheme was applied to the rubber industry to meet a similar situation.

China Clay Wages and Prices

A good deal of correspondence and discussion have followed the letter written by Mr. Fraser, secretary of the Consolidated Mines of Cornwall, Ltd., published in our last issue, suggesting a reduction in the workers' wages to compensate for the stringency producers are suffering consequent upon the price-cutting war. There is keen opposition from the clay workers to such a proposal, and few producers are to be found who favour the adoption of such a remedy. The workers' view is that, much as the China Clay industry is suffering from the present price war, it is not likely that the suggestion to reduce the wages of China Clay workers will be entertained. As a whole, the workers of the industry were not a party to, nor did their organisation favour, the action taken by the producers in breaking up the Association, and therefore it is hardly to be expected that they would readily agree to a cut in prices when, as a result of their own act, producers are now suffering. The China Clay workers may very well ask why they should be called upon to make sacrifices when, as a result of the product of their labours being sold at in some cases unremunerative prices, the workers in China Clay consuming industries are receiving much higher wages. Apart from that, anyone looking at the conditions and strenuousness of the work done in the clay works cannot reasonably say that the present wage of 1s. per hour, which works out at 42s. per week, is at all excessive for the work the men do, and having regard to the present cost of living Whatever may be said of the

workers in other industries, it can never be said of the workers employed in the China Clay industry that they do not put their backs into it, or that the advice to work harder and longer at the same wages can reasonably be pressed upon them at the present time.

The Remedy

The same economic principles must be applied to the China Clay industry as to other industries, namely, that the industry must be capable of being so worked as to yield a fair return to those whose capital is employed in it, whether it be the money of the investors or the labour of the workers. There can be no doubt that the China Clay industry is capable of being worked to yield these results, but it would certainly not be fair for the wages of the workers to be reduced because, through their own short-sightedness, the producers themselves have brought about the present depression in prices. There can be no doubt that China Clay, having regard to its value and its cost of production, is being sold too cheaply, and the only remedy for meeting the stringency that many China Clay firms are experiencing is to keep prices at a remunerative level.

China Clay Trade in 1925

Analysis of First Six Months

WE are able this month to give specially analysed figures of the volume and course of trade (China Clay and China Stone) for the first six months of the year. In order that the industry may see in which directions business has progressed or receded in the case of particular countries, we also give the figures for the complete years of 1923 and 1924.

Half-Yearly Comparisons

Striking a half-yearly average, the figures this year compare with the previous two half-years' total trade as follows: 1925, 464,858 tons; 1924, 429,371 tons; 1923, 398,932. Taking the export and home tonnage separately, the half-year average of 1924 and 1923, compared with this half-year's figures, are as follows: Exports: 1925, 313,859; 1924, 301,695; 1923, 260,373. Home: 1925, 150,999; 1924, 127,671; 1923, 138,559.

On the half-year, compared with the half-yearly average of the same two years, we find that this year's figures show an increase in total deliveries (home and export) of 35,487 tons on the 1924 tonnage, and 65,926 tons on the 1923 tonnage. Taking the export and home tonnage separately, the export increase on 1924 is 12,164 tons, and on 1923, 53,486 tons; the home tonnage 23,323 tons on 1924, and 12,440 tons on 1923. Averaging the prices of the total tonnage for each year, it will be seen that there has been a drop from 1923 of 7s. 6d. per ton, and from 1924 of 5s. 6d. per ton. An examination of the trade as disclosed by the figures given below is published in our editorial page.

Exports to Foreign Countries

Country	1923. Quantity. Tons.	1923. Value. £	1924. Quantity. Tons.	1924. Value. £	1925. 1st six months. Quantity. Tons.	1925. 1st six months. Value. £
FINLAND	10,763	21,276	9,976	21,239	4,005	7,132
SWEDEN	19,033	43,661	17,475	36,640	7,275	15,547
NORWAY	13,462	22,623	20,702	37,791	11,147	14,587
DENMARK	2,923	8,032	3,616	10,135	1,264	3,189
GERMANY	6,735	24,285	19,742	48,822	14,322	34,209
NETHERLANDS	22,121	55,146	34,534	84,154	17,599	34,702
BELGIUM	60,519	122,385	57,696	112,173	27,185	47,143
FRANCE	36,046	78,786	35,035	74,276	18,955	34,130
SWITZERLAND	682	1,634	502	1,178	14	36
SPAIN	11,605	36,028	15,183	42,168	5,757	14,797
ITALY	20,193	54,384	27,448	74,424	14,879	35,436
JAPAN	168	1,028	4	26	—	—
DUTCH EAST INDIES	—	—	322	1,293	401	1,519
AUSTRIA	98	320	—	—	—	—
HUNGARY	474	1,560	—	—	—	—
U.S.A.	286,405	680,515	331,900	761,728	176,046	363,010
MEXICO	595	2,496	883	3,731	427	1,712
ARGENTINE	385	1,721	1,571	5,373	269	1,457
OTHER SOUTH AMERICAN STATES	134	607	110	541	49	249
ESTHONIA	1,116	2,226	1,891	3,448	851	800
LATVIA	406	1,051	519	1,015	450	759
POLAND	—	—	408	1,306	—	—
NORTH RUSSIA	—	—	—	—	105	552
OTHER FOREIGN COUNTRIES	267	1,311	321	1,433	91	411
TOTAL FOREIGN TRADE	494,110	1,161,075	579,838	1,323,894	301,091	611,377

Exports to Colonies

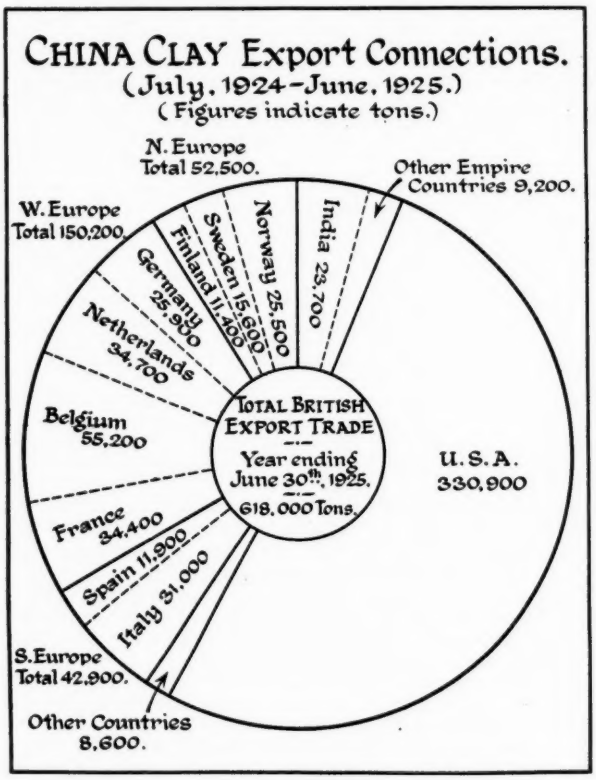
Country	1923. Quantity. Tons.	1923. Value. £	1924. Quantity. Tons.	1924. Value. £	1925. 1st six months. Quantity. Tons.	1925. 1st six months. Value. £
INDIA	16,196	63,528	20,508	79,827	11,482	47,528
CANADA	7,319	19,017	5,756	14,152	656	1,730
NEWFOUNDLAND	2,489	4,600	2,802	5,157	—	—
SOUTH AFRICA	20	50	3,488	13,255	1	19
AUSTRALIA	397	2,399	448	2,438	252	1,280
CHANNEL ISLES	—	—	395	889	309	248
OTHER BRITISH POSSESSIONS	215	777	155	565	68	159
TOTAL BRITISH TRADE	26,636	90,371	23,552	116,283	12,768	50,964
TOTAL OVERSEAS TRADE	520,746	1,251,446	603,390	1,440,167	313,859	662,341
TOTAL HOME TRADE	277,118	678,939	255,352	606,410	150,999	309,057
TOTAL, HOME AND OVERSEAS	797,864	1,930,385	858,742	2,046,577	464,858	971,398
AVERAGE PRICE PER TON	£2 9 0		£2 7 6		£2 2 0	

Growth of China Clay Exports

Better Overseas Demand

CHINA CLAY exports are growing continuously. Throughout the whole of the past four years a well-sustained upward movement is reflected by the figures, commencing with the record advance in 1922 to 503,000 tons, which became 522,000 tons by 1923, improving still further to 614,000 tons in 1924, whilst the totals of more recent months indicate that the trend of progress is by no means exhausted. The half-yearly statistics for the period ending June 30 are in fact 4,500 tons better than were recorded twelve months ago, and as much as 49,000 tons above the total for the first half of 1923. The industry is coming into its own again with the full resumption of pre-war standards, and it is clear that the reason lies in the reawakening of world-wide demand and growing trade connections over a number of overseas markets.

In the list of monthly export figures we are accustomed to seeing a table of these countries with their purchases during



the current period, and it is well to observe still further the extent to which development in the individual areas is being effected. The United States is our largest customer, and takes an ever greater quantity than before the war, so that annually half our total exports are destined for this direction. During the twelve months ending with June, 1924, the American purchases amounted to 320,000 tons out of a total overseas trade of 567,000 tons, and in no month of the period were larger figures shown by any other country, whilst in very few months of the year did the U.S.A. purchases fall below half our monthly total export. In the succeeding period ending on June 30 last, the U.S.A. aggregate was advanced slightly to 330,900 tons, thus still retaining its pre-eminent position, although not showing the same relative increase which characterises some other areas of the world.

In a number of outside markets the expansion shown by a comparison of the year ending June 30, 1924, with the year ending June 30, 1925, is very striking, and especially satisfactory is the progress of several European countries. Italy, for instance, to which rather spasmodic shipments were recorded in the former period, now takes consignments larger by 66 per cent., and is also sending fairly constant monthly demands. Another area, very similar in the movement to fill up the monthly gaps, is Finland, where the net gain is 20 per cent., whilst the tendency to improvement is also indicated by other portions of the old Russian empire, including Latvia and Esthonia. Among these states of the Baltic area the outstanding case of better business is with Norway, where the previous total of 8,700 tons has been expanded by almost 200 per cent., the new level being fully maintained during the latest months. To a small extent this is offset by a decline of 11 per cent. in shipments to Sweden, but on balance the northern European countries are up by 15,000 tons.

In the nearer continental markets the position, taken on the whole, is again eminently satisfactory. Despite competition from other sources, our exports to Germany are two and a half times greater than in the preceding year, and are, moreover, still growing, whilst the Netherlands trade has increased by 7,500 tons to the present figure of 34,700 tons. Our other strong customers in this direction are located in Belgium, France, and Spain, with each of which there has, however, been a perceptible drop, estimated in connection with the first-named at 10 per cent., but not above 4 per cent. with the other two, so that the basic strength of demands from these countries is scarcely touched.

Further afield there are several important markets which have yet to be developed, notably in South America and the Dominions. Effective business with centres in these areas should result from future activity, and as an example of good business with more distant markets the soundness of Indian trade may be quoted.

Generally speaking, the industry can count upon an average monthly export of 50,000 tons, and since it is so highly dependent for its prosperity upon overseas demands, the fact that these are now fluctuating monthly within much narrower limits augurs well for steadier trade.

Paper Filler Values

Home China Clays Favoured

IN a paper dealing with the comparison of American and foreign clays as paper fillers, Messrs. Merle B. Shaw and George W. Bicking, of the U.S. Bureau of Standards, state that comparative paper runs have been made in the experimental mill of the Bureau of Standards, using five American and three foreign representative commercial clays as fillers. Tests have also been made on the physical properties of the clays. Additional data on clay retention in paper and losses in white paper were obtained on samples taken in a commercial paper mill from a machine in operation. The amount of clay retained in the paper at any of the places of sampling is practically independent of the kind of clay used. The physical characteristics of the finished paper (bursting strength, finish, etc.) were essentially the same for all the clays. The study of the white water losses in a commercial paper mill showed the percentage of clay retention in paper to be considerably increased by the use of a saveall. The saveall not only increased stock recovery by permitting the re-use of water with high concentration of stock for dilution purposes, but also affected a saving of thousands of gallons of water. The retention data of the commercial mill test agree with those of the duplicate work in the experimental mill of the Bureau, thus showing the applicability to the paper industry of data derived from experimental runs in the Bureau of Standards' paper mill. Differences were noted in the physical properties of the clays, colour and grit tests favouring those of foreign source.

Grain Sizes of a Filler

In a paper on "The Size and Character of Grains of Non-Metallic Mineral Fillers," Mr. W. W. Weighel, of the U.S. Bureau of Mines, expressed the belief that a better knowledge of the average size of the particles, the distribution of the sizes throughout the mass and the character of the surface and shape of the individual grains would result in a more efficient use of the non-metallic fillers, and would often indicate the proper material to be used for a specific purpose without the expense and delay occasioned by having to try a large number of actual compounding or experimental manufacture. A brief outline of the various methods of computing average particle size was given and reasons were advanced for advocating the use of the average based on specific surface as especially applicable to fillers. The average diameters, as based on specific surface, for the grains of a number of representative fillers in common use were stated.

"China Stone"

By China Clay "Captain"

CLOSELY allied to the China Clay industry is the china stone industry. Practically all the large China Clay firms have china stone quarries; sometimes they are close together and worked conjointly—slices of stone intersecting or overlying the clay bed.

The lessors of properties where clay and stone lie side by side are indeed fortunate if the clay and stone rights have been acquired by one firm, as in nearly every clay-pit "hardness" develops on one side or the other, that is, an "island" begins to grow in the bottoms.

This is looked upon as a nuisance and an expense in the shape of reduced production and costly handling of "Stent," so if the otherwise waste product can be converted into an article of commercial value it is all to the good.

But china stone is not only a by-product of China Clay, it is quarried extensively on its own account. In the parish of St. Stephens in Brannel, Cornwall, large quarries may be seen, and at least four successive generations have quarried china stone. I have heard that William Cookworthy, who did so much for the clay and stone workers by his researches in pottery materials, visited the parish, and while attending the fine church noticed that the pillars supporting the nave resembled Chinese petuntse. On inquiry he learned that the stone had been taken from a quarry at Carloggas on the Boconnoc estate.

The late Mr. Robert Varcoe, of Resugga, who was for years mineral steward on Mr. Bevil Fortescue's estate, when responding to the toast of China Clay and Stone at the annual rent audit, used to talk in his racy, inimitable way to the farmers and small-holders—who were mostly connected directly or indirectly with the allied industries—and told them that they ought to erect a statue to William Cookworthy on the Foxhole Beacon overlooking the clay and stone area; and, furthermore, every man jack of them ought to wear calico shirts, smoke long, clay pipes, and drink only out of china cups to patronise their own industry, and honour by remembrance a sturdy pioneer who had added considerably to the prosperity of the neighbourhood.

Quarrying

The art of successful quarrying has to be learnt; it is not a job that the casual labourer can pick up in a week. Usually the embryo quarryman starts as toolboy, and between fetching and carrying tools he helps to clean the stone with a "slad-axe," a process which is known as "chipping." In this way, under the direction of the older hands, he is taught how to sort stone, to store the hard and mild purple in different piles and to separate the china lumps from the dry-white. He also learns to detect and eliminate "shell," which has no commercial value (apart from building stone), though the uninitiated would be unable to tell the difference between it and good stone.

As he grows older he has to learn the grain of stone—the splitting and cutting ways—how to cleave it to the best advantage, to use the pick and gad, the swell-jumper, the hammer and drill, or, where they are installed, the rock drills. Before he is a fully fledged china stone worker he must know how to space the holes, to make a "leggo," and get the best results while blasting, how to handle explosives, what signals to give during blasting operations (as the rules and regulations of the Quarries Acts are very stringent, and rightly so,) to prevent accidents.

It is interesting to note the changes in the explosives. Old quarrymen, when I was a lad, used to tell how dry wood or new powder lime was driven or packed tightly into holes and water poured on it, causing the wood or lime to expand and split the stone. Then black grain powder came into vogue, which was easy to tamp into a dry hole, but it required a considerable amount of ingenuity to keep the powder dry in a wet one (and as the quarries went deeper they were continually "cutting water") so it was usually done by placing it in a greasy bag, or "claying up" the hole.

After a time red sticks of dynamite came into use; now nitro-glycerine or gelignite is almost exclusively the explosive used. It can be placed in wet or dry holes with water or sand tamping, has a shattering effect which breaks down the stone into handy lumps, and is an ideal explosive for quarrying china stone, although for "rising" building stone, powder is preferred. After china stone is quarried it still has to be ground before use in the potteries. Some firms grind it before shipping, while others ship it in the raw state.

Pottery Industry's Condition

Inquiry Reveals Interesting Facts

AT a meeting of the Committee on Industry and Trade at Stoke, in connection with the National Council of the Pottery Industry, the evidence of witnesses revealed some important facts about the pottery industry that should prove interesting to China Clay and China Stone producers, especially in regard to the working of industrial councils. Major F. H. Wedgwood, Mr. A. D. Jones, Mr. S. Clowes, M.P., Mr. W. Ancock and Mr. F. H. Hind constituted the Committee.

It was stated that the industry employed 60,000 operatives, of which number 78 per cent. were engaged in the North Staffordshire district. The Pottery Council was the first National Joint Industrial Council to be established, its first meeting being held on January 11, 1918, and the industry was now well organised. To improve this still further, the witnesses said, posters were displayed on factories recommending all operatives to join their union, and manufacturers were requested to grant facilities to trade union officials for propaganda work. The constitution of the Council provided for the consideration of wage questions, but it was considered wise to continue the previously existing method of direct negotiations between the employers' and workers' organisations. In the light of experience gained the Council was convinced that this decision was a wise one, as only on two occasions had the services of the Council been requested on wages questions, and in each case its suggestions had led to satisfactory conclusions. During the last wages inquiry, the witnesses mentioned, a confidential investigation was made by an independent accountant covering comparative selling prices, earnings, costs, and aggregate profits in the industry. Being free from the consideration of wage questions, the Council had been able to devote its energies to the main object underlying the "Whitley" principle—the regular consideration of matters affecting the progress and well-being of the trade, and it was contended that the most important general effect had been the better relations between employers and employed and the better understanding by each side of the difficulties of the other.

Industrial Council Agreements

As regards the welfare of the industry, the witnesses stated that working conditions of the operatives had been improved in various directions. Research had been made by a special committee into such matters as ventilation, lighting, health and welfare conditions, the regulation of apprenticeships and education, etc. Much had been done in the way of establishing Works Committees, many of which were doing valuable work. An interesting point was that statistics were from time to time furnished through the National Council in relation to wages, making and selling prices, average earnings, the average percentage of profits on turnover, etc. The Council had also devoted attention to such questions as foreign competition and trade marks, transport, termination of engagements, the method of payment of wages, etc.

The witnesses stated that the Council advocated the legal enforcement of agreements, and had strongly supported the "Industrial Council's Bill," promoted by the Association of Joint Industrial Councils, which Bill passed its second reading in 1924, but owing to the dissolution of Parliament could not then be proceeded with. The lack of some such provision was, in the opinion of the Council, a distinct weakness of the Industrial Council movement, and the witnesses suggested that the Bill should be re-introduced to Parliament and receive official support.

Dealing with their experience of the Joint Industrial Council, the witnesses said that in the view of the Council much might be expected of this form of organisation if carried out on the lines as visualised by the Whitley Committee. To ensure the greatest results, however, it was imperative that organisation, both on the employers' and workers' side, should be improved, so that all engaged in industry might feel that they had a share of the responsibility.

China Clay Notes and News

Mr. Walter Sessions' Estate

At the last meeting of the St. Austell Parish Council the Clerk reported that he had seen Mr. Walter Sessions (of English China Clays, Ltd.), who recently became the owner of Duporth Estate, a charming seacoast spot between Charlestown and Porthpean, and he had expressed his readiness to meet the Council with regard to the fixing of a seat at the top of the Battery Cliff at Charlestown. His solicitors, Higman and Hubbard, wrote saying that arrangements for the public to use the path through the plantation and to fixing and maintaining the seat could be embodied in a short agreement, subject to the payment of a small acknowledgment each year. It was decided to accept these terms and to thank Mr. Sessions for the very cordial manner in which he had received the Council's proposals.

Pottery in Birmingham

Interesting reference has been made recently to the Ruskin Leadless Glaze Pottery Works, which were founded in 1898 by Edward R. Taylor, formerly headmaster of the Birmingham School of Art. They are located in West Smithick, near Birmingham, and are now carried on by his son, W. Howson Taylor, who has inherited not only the artistic instinct of his father, but also that of the artist-craftsman. All the various processes in connection with the pottery are carried on there, from the mixing of the clay (which comes from Devon and Cornwall) to the final firing in the kiln; whilst the "seggars" or coarse earthenware cases in which the articles are placed for firing, are also made there in spare moments. The operations of throwing and moulding the "pots" are done by men, but girls are employed in the lighter branches of the work, including the simple decoration occasionally used on some of the specimens, as well as in spraying and glazing. No lead, however, is employed in making the glazes or colours, and employees work under very pleasant conditions. The variety of articles made at the works include sweet dishes, preserve jars, powder bowls, enamels for insertion in jewellery, metal work and furniture, cruets, sleeve links and buttons, as well as the beautiful specimens of pottery in coloured lustre and real flambe colourings which, as a critic says, have "the fine qualities of antique Chinese." To a potter this is the highest praise.

China Clay Worker as Wrestling Champion

The heavy-weight wrestling championship of Cornwall is still maintained by F. Richards, a China Clay worker and an employé of English China Clays, Ltd., in their quarries at St. Stephens. He won his way through before a big crowd of over 2,000 spectators at an exhibition at Calstock under the auspices of the Cornwall County Wrestling Association last month, when there were brought together 16 wrestlers picked from the best men in the county. Some very excellent bouts were witnessed, the chief in the first round being that between Richards and Bazeley. Great interest was centred in the bout between H. Gregory of St. Wenn (who is looked upon as a coming champion), and the renowned Sid Chapman, who has held the championship of Cornwall. The results were:

1ST ROUND.—F. Richards (heavy-weight champion of Cornwall) threw G. Bazeley, of St. Dennis; W. L. Hawkey, of Halviggan, threw F. Scantlebury, of Bodmin; F. C. Gummow, St. Austell, retired through injury while wrestling with W. Cleave, of St. Kew; E. C. Williams, St. Eval, threw G. Bailey, of St. Dennis; H. Gregory, of St. Wenn, threw S. Chapman, of St. Wenn; F. Lean (light-weight champion of Cornwall) threw L. Morcom, of St. Austell; G. Bennett, Nanpean, threw G. Tippett, St. Wenn; J. C. Brewer, St. Eval (feather-weight champion of Cornwall) threw S. Hooper, of Old Pound (youth champion of Cornwall).

SECOND ROUND.—Richards threw Hambly; Williams threw Cleave; Gregory threw Lean; Bennett threw Brewer.

THIRD ROUND.—Richards threw Williams; Gregory threw Bennett.

FOURTH ROUND—Williams threw Bennett; Richards threw Gregory.

The prize-winners were: 1st, F. Richards, Old Pound; 2nd, H. Gregory, St. Wenn; 3rd, F. C. Williams, St. Eval; 4th, G. Bennett, Nanpean.

Kaolin in Insulator Porcelain

In a recent issue of the *Technische Blätter* there is an article on the quality of porcelain used for electric insulators, in which the value of kaolin is emphasised. The chief materials used for making porcelain for electrical purposes are kaolin, quartz, and felspar. The first-named is the chief raw product, the others being added in certain proportions according to the result aimed at. As these proportions vary, so does the porcelain, on firing, sinter together in a varying degree. If, in addition, there be present particles of iron, earth, or the like, it causes spots on firing, or unequal melting of the fluxes, leading to distortion and other troubles in the finished product. Opinions vary as to the consequences of impurities of this nature, some workers holding that they are driven out in the washing of the kaolin, but if the latter is loaded in the loose there is much greater danger of contamination than when it is bagged. As to the actual manufacture, after leaving the pottery in a dry state, the insulators are generally burnt at about 800° C. to drive off mechanically combined and hydrated water from the kaolin, after which they are no longer so fragile. Thereafter the pieces are dusted, glazed, and fired, the temperature for this process being 1,400 to 1,450° C. The chemical reactions involved are of some complexity, for at this high temperature the clayey substance, quartz and felspar react mutually. The felspar first fluxes, partially dissolves quartz and penetrates the interstices of the kaolin particles, filling the latter out and forming a compact whole. The clayey substance dissociates partially and gives up a molecule of SiO_2.

Outlook in Pottery Trade

Unemployment in the pottery industry shows little improvement, except in certain sections, according to a pottery authority. The rate of unemployment fairly accurately represents conditions in the purely pottery sections of the industry. The hopes and prospects at the opening of the year have not been fulfilled. The home market remains inactive, largely owing to foreign competition, and the aggregate of overseas demand, despite the redeeming feature of colonial trade, is considerably below the average. A little more business with the United States is being realised, but the bulk is not comparable with the former importance of this market. This is mainly due to the continued development of the American pottery industry, which is more and more supplying its home market, except for the highest grade wares obtainable only from England. The United States potters, moreover, are gradually extending their activities into other markets—South America, Canada, and even Australia—thus increasing the competition which English wares are encountering. The one flourishing department of the pottery industry is the sanitary ware branch; full time and overtime in some cases has been worked recently. Some of the sanitary ware factories are also being extended considerably to provide for larger output, though the manufacturers are reporting growing competition in foreign markets. Tile manufacturers continue fairly busy, but makers of electrical porcelain have recently experienced a less active time.

China Clay Merchants Encourage Bands

The two pastimes in which China Clay workers take the keenest interest in the summer are band playing and wrestling, and in both they receive tangible encouragement from their employers, who present trophies for competition. Nearly every China Clay village has a band of its own. At the recent Stenalees Band Festival a large number of these bands competed; over 3,000 people attended and patiently listened for 6½ hours while the 11 bands that competed carried through 34 separate performances. The championship in each section was carried off by bands largely composed of China Clay workers, St. Dennis, the Cornish champions, taking the challenge shield presented by Colonel W. T. Lovering (of J. Lovering and Co.) in the premier competition, and Bugle the challenge cup presented by Captain Denis Shipwright (Porthia China Clay Co., Ltd.). Newquay took Mr. John Lovering's (of J. Lovering and Co.) challenge cup as second prize. For the hymn tune in the same section, Newquay took H. D. Pochin and Co.'s challenge cup. The Misses C. and L. Nicholls' (North Goonbarrow Co.) challenge shield for the third

prize in the second section was won by Truro. The challenge shield presented by Mr. D. G. Collins (Cornish Meledor China Clay Co.) as third prize in the test piece of the third section went to Newlyn East. Viscount Clifden's championship challenge cup went to Greensplatt. Sir James Nelson was this year's president and Lady Nelson presented the prizes. The arrangements were well carried through by a committee of which Mr. C. J. Richards was hon. secretary, Mr. E. Whale chairman, and Mr. T. Common hon. treasurer.

Death of Prominent Cornish Solicitor

At the age of 55, the death took place at his residence, "Trevidien," Penzance, recently, of Mr. J. Vivian Thomas. Mr. Vivian Thomas was the senior partner in the firm of Vivian Thomas and Son, solicitors, Penzance, and was well known throughout Cornwall. Deceased was a younger son of the late Captain Josiah Thomas, for many years manager of the famous Dolcoath tin mine, with the management of which the family have been associated for generations, and of which company his brother, Mr. R. Arthur Thomas, is the managing director. Coming from a family whose history was closely bound up with Cornish mining Mr. Thomas naturally took the keenest interest in this industry. He was a director of the Geevor Mines, Ltd., and the famous Levant mine. When the great slump occurred in Cornish mining following the war, he was one of the moving spirits in forming the Joint Industrial Council, of which he became the secretary. In politics, Mr. Vivian Thomas was a Liberal, and acted as agent for Sir Clifford Cory in his earlier contests. He was also actively identified with the Wesleyan church at Penzance, in which he held many offices. He leaves a widow, one son, and one daughter. His elder son was killed in the war.

Compensation Case Adjourned

At the July St. Austell County Court, Mr. J. C. Hubbard (of Higman and Hubbard), in making application for the adjournment of the China Clay compensation case Runnalls, St. Dennis *v.* United China Clay Co., Ltd., in which Mr. J. Vivian Thomas was for the applicant and Mr. Hubbard for the company, said he very much regretted that the application was necessary because of the circumstances. Originally Mr. Thomas was to have been his opponent in that case. On behalf of the solicitors practising in that Court, he expressed their deep regret at the loss of their colleague. Mr. Thomas had practised for many years and had appeared many times in that Court, and had a very extensive practice in Cornwall. Mr. Thomas, with the exception of one or two small Courts, had appeared in every Court in the county. He expressed their very deep sense of loss of a colleague whom they so much esteemed.

His Honour, Judge Gurdon, in agreeing to the adjournment, said Mr. Thomas had practised before him at a large number of Courts in the Circuit and he had found him, as they had, always an ideal person for the position he occupied. Mr. Thomas was a sound lawyer, a very able advocate, a generous friend, and a person whose loss they all deplored. He felt that the Bench and Bar of the district would be much the poorer by his death.

Mr. Thomas had appeared in several important cases at St. Austell, the most famous being for the prosecution in the constable wounding case during the Clay strike and in the Black murder case. His most recent appearance was in May. He had also acted on behalf of the China Clay Employers' Federation in the presentation of the employers' case in wages negotiations.

Canadian Pulp and Paper

A PRELIMINARY Report on the Pulp and Paper Industry of Canada in 1924 has recently been published by the Dominion Bureau of Statistics, Ottawa, covering operations in the woods with pulpwood as a product, the manufacture of wood pulp and the manufacture of paper. There were, the report states, 115 mills in operation in 1924, as compared with 110 in 1923, and the value of paper produced increased by 4·1 per cent. The exports of paper and paper goods amounted to $99,248,497, as compared with $93,770,957 in 1923. Imports amounted to only $9,327,942, but showed an increase over those for 1923.

China Clay Workers' Wages

Proposals for a New Agreement

THE last six months' agreement negotiated by the Joint Industrial Council of the China Clay industry has expired, and the Workers' Union has submitted terms for a new agreement. These include an application for an increase of the rate per hour from 1s. to 1s. 2d. for day workers, with a corresponding increase for piece-workers, four paid holidays a year, and certain improvements in working conditions. We give below the details of the proposals, together with explanations as to where they materially differ from the old agreement.

New Proposals

That the rate of wages for the next six months be 1s. 2d. per hour for day workers, with a proportionate increase for piece-workers. (The present rate is 1s. per hour.)

Washers to receive 1d. per hour above the daywork rates. Washers to be provided with oilers. (This is a new condition.)

Enginemen to be paid the minimum rate for every hour the engine is working, but meal time hour not to count for overtime.

Men working at blacksmiths', carpentery, and masons' work to be paid 2d. per hour over the ordinary rate, but carpenters who provide their own tools to be paid 3d. per hour above the ordinary rate. (This is a variation of the previous agreement.)

Overtime to be paid at the rate of time and a quarter for ordinary days. Ordinary Sunday work, such as pumping, time and a half. All special work on Sundays, double time.

Pieceworkers to be given a price that will enable them to earn not less than time and a third over the ordinary day rate. Piece-workers not to work less than six hours. (The hours referred to here will include brickmakers and pogmill men, provided they complete their tasks.)

Hours of work to be from 7 a.m. to 3.30 p.m., with one hour for meals for the first five days. Saturdays from 7 a.m. to 12 noon, with half-hour for meals. Enginemen, washers, draymen, and loaders are to be exempt from the above arrangements. The winter and summer change of time still to apply. Night shift workers to work five shifts with pay for six.

Half payment to be made for wet time.

That four holidays be granted per year with pay. The holidays to be Easter Monday, Whit Monday, August Bank Holiday and Boxing Day. (New condition.)

Every boy must get a proportionate increase of all increases given to men in proportion to his pay. New boys to start at 2s. per day. (This compares with 1s. 9d. in the old agreement.) It is agreed that where a pit committee consider that any boy is worthy of higher rates of pay it shall have power to recommend same to the employers.

Where day workers are put to work with piece-workers, it is agreed that the pit committee should meet and report to the Council any cases where piecework rates are suggested to be applicable.

That pit committees shall be set up in all pits, and be recognised.

Any complaint must in the first instance be considered by the pit committee, and in case of non-settlement it must be brought before the Joint Standing Industrial Council to adjudicate upon and settle.

One week's notice to be given by either side to terminate employment.

Proposals Not Acceded to

The proposals were considered at a special meeting of the China Clay Employers' Federation on July 24 at St. Austell, when it was moved, seconded and carried unanimously that, having regard to the state of the trade, no alteration could be made in the rate of pay or working conditions. In the course of discussion it was explained in regard to the washers that these men were put on that work largely because they were not fit for any other work, and that if it was insisted that these men should be paid more than the day workmen a great number of the old men so employed would have to be discharged.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—July, 1925

Arrival Date.	Name.	Sailing Date.	Destination.
July 1,	S.S. *Dorset Coast*	July 3,	Birkenhead
July 1,	S.S. *Rayford*	July 3,	Bo'ness
July 1,	S.S. *Ralum*	July 3,	Helsingborg
July 2,	S.S. *Gouwestroom*	July 4,	Amsterdam
July 1,	S.S. *Monksville*	July 4,	Weston Pt.
July 2,	S.S. *Mary Summerfield*	July 4,	Garston
July 2,	S.V. *Pacific*	July 4,	Par
July 2,	S.S. *Moygarrow*	July 4,	Leith
July 4,	S.S. *Baron Minto*	July 16,	Philadelphia
July 4,	S.S. *Ferndene*	July 10,	Antwerp
July 4,	S.V. *Francis and Jane*	July 30,	Runcorn
July 4,	M.V. *Hope*	July 7,	Par
July 5,	S.S. *Essonite*	July 10,	Antwerp
July 5,	S.S. *Mersey*	July 7,	Ridham
July 6,	S.S. *Delegat*	July 12,	Leghorn
July 6,	S.S. *Ravenspoint*	July 9,	Genoa
July 6,	S.S. *Ashton*	July 9,	Newcastle
July 3,	S.V. *Adelaide*	July 15,	London
July 7,	S.S. *River Fisher*	July 11,	Preston
July 8,	S.S. *Clara Monks*	July 10,	Runcorn
July 9,	S.V. *Emily Warbrick*	July 22,	Weston Pt.
July 9,	M.V. *Shamrock*	July 9,	Plymouth
July 6,	S.S. *River Humber*	July 9,	Newport
July 9,	S.S. *Hill*	July 14,	Drammen
July 9,	M.V. *Elna*	July 11,	Reval
July 9,	S.S. *St. Mawes*	July 9,	Gweek
July 9,	S.V. *Jeanne*	July 21,	Rochfort
July 9,	S.S. *Portadown*	July 10,	Preston
July 9,	M.V. *Roselyne*	July 11,	Boulogne
July 9,	S.S. *Falmouth Castle*	July 10,	Runcorn
July 10,	M.V. *Cornelia*	July 21,	Wiborg
July 10,	S.S. *Claretta*	July 18,	Runcorn
July 10,	M.V. *Noordcap*	July 15,	Antwerp
July 10,	S.V. *Waterwitch*	July 23,	Garston
July 11,	S.S. *Astro*	July 16,	Gothenburg
July 11,	S.S. *Homedale*	July 16,	Antwerp
July 11,	S.S. *Cornish Merchant*	July 18,	Ridham
July 12,	M.V. *Leeuwerck*	July 16,	Stettin
July 12,	S.V. *Aube*	July 25,	Harburg
July 12,	S.S. *Tricentrol*	*	Laid up
July 12,	S.S. *Fermain*	July 17,	Bilbao & Passages
July 13,	S.S. *Berk*	July 16,	New York
July 13,	M.V. *Kongdybet*	July 16,	Odense
July 13,	M.V. *Shamrock*	July 14,	Plymouth
July 15,	S.S. *Blush Rose*	July 17,	Preston
July 15,	S.S. *Brilliant*	July 21,	Rouen
July 14,	M.V. *Liesbet*	July 17,	Reval
July 15,	S.S. *Devon Coast*	July 18,	Liverpool
July 15,	S.V. *Bessie*	July 30,	Leith
July 15,	S.S. *Millocrat*	July 18,	Lancaster
July 15,	S.V. *Esther*	July 27,	Raumo
July 15,	S.V. *Confidence*	July 22,	Charlestown
July 16,	M.V. *Shamrock*	July 18,	Plymouth
July 16,	S.S. *Gouwestroom*	July 21,	Amsterdam
July 16,	S.S. *Hertha*	July 24,	Montreal
July 17,	S.S. *Topaz*	July 22,	Terneuzen
July 17,	S.S. *Farfield*	July 22,	Antwerp
July 17,	M.V. *Lydia Cardell*	July 23,	Rouen
July 20,	S.S. *Dicky*	July 22,	Newlyn
July 18,	S.S. *Falmouth Castle*	July 23,	Runcorn
July 19,	S.S. *Polly*	July 22,	Seville
July 18,	M.V. *Hope*	July 25,	Torquay
July 20,	S.S. *Lancaster Castle*	July 31,	Portland Me.
July 20,	S.S. *Alice*	July 24,	Runcorn
July 20,	S.S. *Ciscar*	July 23,	Genoa
July 20,	S.S. *Guelder Rose*	July 25,	Bo'ness
July 22,	S.S. *Pylades*	July 27,	Methil
July 22,	S.S. *Wheatsheaf*	July 28,	Antwerp
July 22,	S.S. *Normal*	July 25,	Drammen
July 23,	S.S. *Fleiss*	July 28,	Harburg
July 24,	S.V. *Elsa*	*	Newcastle
July 25,	S.S. *Bangor*	July 28,	Bristol
July 22,	S.V. *Mary Barrow*	*	
July 25,	M.V. *Frederike*	July 30,	Ahno
July 25,	S.S. *Brynawel*	July 30,	Runcorn
July 27,	S.S. *Ferndene*	July 30,	Santander
July 28,	S.S. *Calluna*	Aug. 5,	Brussels
July 29,	S.S. *Shoreham*	Aug. 1,	Weston Pt.
July 29,	S.S. *Halton*	Aug. 1,	Liverpool
July 31,	S.S. *Falmouth Castle*	Aug. 1,	Weston Pt.
July 31,	M.V. *Locking Naval*	Aug. 4,	Stockholm
July 30,	M.V. *Vestland*	Aug. 2,	Trangsuner
July 31,	M.S. *Virginia*	Aug. 5,	Norkopping
July 31,	S.S. *Elizabetta*	Aug. 6,	Cape Verde Islands

* In port.

Charlestown Shipping—July, 1925

Arrivals

Date.	Vessel.	From
July 2	*Haldon*	London
July 4	*Orenie*	Cork
July 5	*Jeanne*	Bordeaux
July 6	*Magrise*	Par
July 8	*Portadown*	Salcombe
July 9	*Glen Helen*	Rouen
July 9	*Cornish Merchant*	Cardiff
July 12	*Treleigh*	Portreath
July 18	*Crossbill*	Cardiff
July 18	*Nalan*	Exmouth
July 22	*Flying Foam*	Truro
July 23	*Pedestrian*	Par
July 23	*Confidence*	Abo
July 25	*Ryelands*	Cardiff
July 29	*Zeehound*	Trangsund

Sailings

Date.	Vessel.	Destination.
July 4	*Hector Cundy*	Rochester
July 4	*Lady Daphne*	Rochester
July 7	*Orenie*	Tayport
July 8	*Magrise*	London (Gravesend)
July 9	*Jartiana*	Leith
July 9	*Portadown*	Preston
July 10	*Glen Helen*	Manchester
July 11	*Cornish Merchant*	Fowey
July 12	*Treleigh*	Preston
July 21	*Nalan*	Brussels
July 21	*Crossbill*	London
July 23	*Katie*	Rochester
July 24	*Flying Foam*	London
July 24	*Pedestrian*	London

Par Harbour Shipping—July, 1925

Arrivals

Date.	Vessel.	From
July 2,	M.V. *Liesbet*	Kotka
July 3,	S.V. *Alice Williams*	Mevagissey
July 3,	S.V. *Volant*	Looe
July 4,	S.V. *William John*	Truro
July 4,	M.V. *Haldon*	Charlestown
July 4,	S.S. *Magrix*	Teignmouth
July 4,	S.V. *Pacific*	London
July 7,	M.V. *Hope*	Fowey
July 7,	S.V. *Triumph*	Fowey
July 9,	S.S. *Mia*	Truro
July 9,	M.V. *Regina*	Plymouth
July 10,	S.V. *W. E. Gladstone*	Plymouth
July 10,	S.S. *Tanny*	Avonmouth
July 10,	M.V. *Katie*	Exmouth
July 11,	S.V. *Shortest*	Plymouth
July 11,	S.V. *Alert*	Falmouth
July 15,	M.V. *Hope*	Plymouth
July 16,	S.V. *C. F. H.*	Newlyn
July 16,	S.V. *Eclipse*	Porthoustock
July 16,	S.S. *Wheatfield*	Newport
July 18,	S.S. *Fleiss*	Carlstad
July 19,	S.V. *Welcome Home*	Falmouth
July 19,	S.S. *Castlerock*	Newport
July 20,	S.V. *Fanny Crossfield*	Treguica
July 20,	S.V. *Pedestrian*	London
July 23,	M.V. *Regina*	Plymouth
July 23,	S.S. *Treleigh*	Barry
July 23,	S.V. *Margaret West*	Falmouth
July 25,	S.V. *Eclipse*	Porthoustock
July 30,	M.V. *Hope*	Plymouth
July 30,	S.S. *Robrix*	Plymouth
July 31,	S.V. *Passmore*	Falmouth

Sailings

Date.	Vessel.	Destination.
July 1, S.S.	*Teign*	Penarth
July 2, M.V.	*Garlandstone*	Gloucester
July 2, S.S.	*Treleigh*	Runcorn
July 3, S.V.	*Penryn*	London
July 4, M.V.	*Englishman*	London
July 6, M.V.	*Haldon*	Penryn
July 6, S.S.	*Magrix*	Charlestown
July 7, S.V.	*Rose*	London
July 8, S.V.	*Mary Ann Mandall*	London
July 8, S.V.	*Alice Williams*	London
July 8, S.V.	*Volant*	Runcorn
July 9, M.V.	*Pacific*	London
July 9, M.V.	*Hope*	Plymouth
July 9, S.S.	*Mia*	Preston
July 9, M.V.	*Regina*	Pentewan
July 10, S.V.	*Triumph*	Plymouth
July 10, S.S.	*Tanny*	Newlyn
July 13, S.V.	*Shortest Day*	Pentewan
July 14, M.V.	*Liesbet*	Fowey
July 14, S.V.	*W. E. Gladstone*	Pentewan
July 16, M.V.	*Hope*	Pentewan
July 17, S.S.	*Wheatfield*	Cardiff
July 20, S.V.	*Eclipse*	Falmouth
July 21, S.V.	*Castlerock*	Newlyn
July 21, M.V.	*Katie*	Charlestown
July 22, S.V.	*Pedestrian*	Charlestown
July 23, S.V.	*C. F. H.*	Plymouth
July 23, S.S.	*Fleiss*	Fowey
July 24, M.V.	*Regina*	Pentewan
July 25, S.S.	*Treleigh*	Preston
July 25, S.V.	*Eclipse*	Falmouth
July 31, S.S.	*Robrix*	Truro

Par Harbour Tide Table, August, 1925

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	15	2.56	3.33	10.0
Sunday	16	4.6	3.33	10.10
Monday	17	5.1	5.25	11.7
Tuesday	18	5.45	6.6	12.2
Wednesday	19	6.25	6.43	11.3
Thursday	20	6.59	7.17	11.9
Friday	21	7.34	7.48	12.2
Saturday	22	8.4	8.19	12.4
Sunday	23	8.33	8.50	12.6
Monday	24	9.7	9.23	12.2
Tuesday	25	9.40	9.58	11.9
Wednesday	26	10.19	10.42	11.3
Thursday	27	11.3	11.32	10.8
Friday	28	—	0.3	10.2
Saturday	29	0.39	1.22	10.2
Sunday	30	2.5	2.48	10.9
Monday	31	3.29	4.6	11.9

E. CLEMENS, Harbour Master.

July China Clay Deliveries

IT will be noted by the figures of trade done in July that there was an increase of about 2,000 tons on the total tonnage in all classes, china stone and ball clay being responsible for the increase, China Clay having dropped by this amount from the June total. A significant fact is the big drop in the ball clay delivered by China Clay firms compared with the corresponding month last year. This is accounted for by the much lower prices now ruling for China Clay. Details :—

Port.	China Clay. Tons. 1925.	1924.	China Stone. Tons. 1925.	1924.	Ball Clay. Tons. 1925.	1924.	Total. Tons. 1925.	1924.
Fowey	55,075	53,524	5,850	4,424	2,787	8,005	63,712	65,953
Charlestown	3,636	3,374	—	—	—	—	3,636	3,374
Par	2,976	5,270	370	904	—	—	3,346	6,174
Plymouth	1,731	2,386	31	19	—	—	1,762	2,405
Newham	—	—	310	—	—	—	310	—
By Rail	4,624	4,397	—	—	—	—	4,624	4,397
Totals	67,032	68,951	6,561	5,347	2,787	8,005	77,390	82,303

China Clay Plant Wanted

AN Indian correspondent is inquiring for the names of makers of machinery for refining China Clay, to give an output of 5,000 tons of refined clay per year. The China Clay is mined " dry " and is produced in a finished state solely for use in textile mills. We shall be pleased to place interested firms in touch with our correspondent.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BRICK AND TILE INDUSTRIES, LTD., Hull. Registered July 13, two mortgages, to bank ; charged on properties at Hessle, with machinery, etc.

BRITTAINS, LTD., Hanley, paper manufacturers. Registered July 1, £5,000 debentures, part of amount already registered ; general charge. *£50,000. April 2, 1925.

GROSE AND STOCKER, LTD., Stoke-on-Trent, China Clay merchants. Registered July 17, £20,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £18,000 ; general charge.

HENSBARROW UNITED CHINA CLAYS, LTD., London, E.C. Registered July 2, £50,000 prior lien debentures ; general charge. *£100,000. December 31, 1924.

HOOK (C. TOWNSEND) AND CO., LTD., Snodland, paper manufacturers. Registered June 29, two Trust Deeds, dated June 23, 1925, and June 24, 1925 (supplemental to trust deeds dated November 11, 1887, and January 4, 1893, securing £50,000 debenture stock and £20,000 second debenture stock) ; charged on properties at Snodland. *£72,000. March 17, 1925.

OSLER (F. AND C.), LTD., Birmingham, glass and china manufacturers. Registered July 25, £50,000 mortgages, to O. Bird, Woodlawn, Solihull, manufacturer ; charged on 100 and 102, Oxford Street, W., etc. *£30,000. February 4, 1924.

PRENTON TILE AND TERRA COTTA CO., LTD. Registered July 1, £15,500 mortgage, to C. N. Bryan, Red Cottage, Brunswick Road, Douglas (I. of M.) ; charged on property at Woodchurch Road, Prenton, with machinery, etc. *Nil. September 1, 1924.

SKEGNESS BRICK AND TILE CO., LTD. Registered June 30, £1,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £100 ; general charge. *£2,450. February 12, 1925.

Satisfactions

CRAVEN, DUNNILL AND CO., LTD., Jacksfield, tile manufacturers. Satisfaction registered July 22, £4,000, registered January 6, 1916.

NATIONAL PAPER AND PULP CO. (1920), LTD., London, E.C. Satisfaction registered July 16, £3,000, part of amount registered January 26, 1921.

Modern American Brickwork

IN an article contrasting British and American standards for bricks and brickmaking, Professor C. H. Reilly, Liverpool University, writing in *The British Clayworker*, says : " Modern American brickwork is a beautiful thing and worthy of introduction into any building, however prominent. Unfortunately, we must face the fact that modern English brickwork, especially in the industrial North, is generally the reverse. There is no reason why this should be the case, and every reason why it should not. The brickmakers have it in their own hands. Let them follow the lead of their American colleagues, both in the sizes and kinds of facing bricks they put on the market and in their method of educating the public in their use. If they take anything like the pains their American colleagues have taken, bricks and brickwork will soon regain over here the position and repute they rightly held in the eighteenth century.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

A Year of Free Competition

IT is just a year since the China Clay Producers' Association, which embraced the producers of all grades of China Clay, came to an end, and the industry has since had experience of the unrestricted competition that followed upon its dissolution. As some of the most prominent China Clay producers predicted at the time, in consequence of the severe price-cutting that has been going on during the last twelve months, many thousands of pounds have been lost to the China Clay industry, with corresponding loss to others who are indirectly interested. It has taken some time for the altogether unreasonable drop in prices to have its effect upon the finances of the less substantial companies, but twelve months' price-cutting is at last telling its tale and convincing the producers, amongst whom are those who brought about the downfall of the old Association, that unrestricted price-cutting in times of over-production is anything but beneficial. The firms who produce only common China Clays are experiencing most loss, in consequence of their having no best clays, which do not have to face such severe competition and on which there is a substantial margin of profit. Already some of these common China Clay works have closed down because of financial stringency or in order to await an improvement in prices, which it is hoped will accrue from the encouragement of a bigger demand

Increased Demand Hopes Unfulfilled

The hope of some of the producers, who were indifferent as to whether the old Association was continued or not, has not been fulfilled. They imagined that a break in prices would immediately result in an overwhelmingly increased demand, but with all the severe cutting, the turnover for the eight months this year has increased by only 48,000 tons, nearly 7,000 tons of which has been substituted for ball clay, a section in which trade was already being done by China Clay firms. Even this increase of 48,000 tons cannot be set down entirely as the outcome of the drop in prices, for last year, even at the Association prices, the volume of trade was progressive, and would have accounted for a large quantity of the increased tonnage that has actually been done. The point we wish to emphasise is that the increased trade following upon the extreme lowering of prices has not been considerable, and has certainly not justified the break-up of the Association on that account. To look for a hardening of prices by force of demand, at a substantially higher figure than has been ruling for some time, is, from the experience of the last twelve months, not very promising, and unless something is done to bring all the producers together again with a view to a working arrangement for the protection of the interests of the industry as a whole, the position will become worse instead of better.

A hopeful sign for the success of a new Association is the almost unanimous opinion that now prevails in China Clay circles in favour of such an organisation. We understand that tentative steps have already been taken with a view to the calling of a meeting of all the producers next month. A prominent Cornwall county gentleman, independent of the China Clay industry, has signified his willingness to preside, if it be the wish of the industry to discuss the situation in order to find a basis of operation whereby the present ruinous internal competition may cease. Apart from the immediate loss sustained by works through having to restrict their production, and in some cases to stop altogether, the situation is having an effect upon the employment possibilities of Devon and Cornwall, because all work is being restricted to the narrowest possible limits. Development work—which has always been a source of considerable employment—is almost at a standstill. If such a meeting as is suggested be held, there is no doubt that it will be very largely attended, but the outcome of it will largely depend on the attitude of the leading producers, who are reluctant to co-operate in another Association unless practical unanimity is secured and there is some prospect of the new Association being permanent.

The Wages Question

While the China Clay Employers' Federation, at their recent meeting, were unable to assent to the application made on behalf of the China Clay workers for increased rates of pay and improved conditions of labour, their decision to continue the present rates has given general satisfaction. They declined to entertain any move in the direction of any lowering of the present rates, though the severe stringency that is being experienced by many China Clay firms might justify it on purely economic grounds. If, on the other hand, an increase had been made in the pay-rolls of individual works they would undoubtedly have been under the necessity of lessening the number of men employed, which would have been very undesirable in the present state of the labour market. Apart from the time being inopportune, there is not very much to find fault with in the application put forward by the Workers' Union on behalf of the men, and if the trade was flourishing and not suffering from the effects of over-production and the absence of machinery to stabilise the price, the industry would in all probability be willing to concede it. As it is, the hard fact has to be faced that many firms are finding it difficult to meet the present cost of working their concerns, without increasing it. Apart altogether from capacity to pay higher wages, the employment side of the industry is suffering from the present policy on account of the restriction of works of development as distinct from the production side. The removal of overburden, the sinking of shafts, the driving of levels, and other works which are undertaken when the industry is flourishing, are being restricted to the barest necessity, thus seriously limiting the opportunities for employment. While the industry is suffering from the competition among the producers themselves, more economical systems of working are being adopted to reduce costs in order to counteract to some extent the pressure of circumstances. Coal costs are being reduced by the introduction of electric machinery for power purposes, and even in the dries the coal heating process has been superseded in some cases by oil fuel. "Necessity is the mother of invention" is an axiom that the China Clay producers have been forced to appreciate, and such as are in a position to stand the capital outlay are determined not to be beaten by the economic pressure of the existing situation.

China Clay Works Fatality

Reserved Judgment in Compensation Case

A CASE having an important bearing on accidents in China Clay works and the liability of China Clay producers was contested before Judge Gurdon at the last County Court at St. Austell, when William James Runnalls, of 3, Alexandra Terrace, St. Dennis, formerly " Captain " at Western China Clay Works, claimed from the United China Clay Co., Ltd., the proprietors of the Western China Clay Works, £300 compensation for the death of his son, Idros Roy Runnalls, who was killed by the explosion of an old carbide generator which he was trying to light while employed in the engine house at the works on October 17 last year.

Mr. Eric Thomas, of Penzance, was for applicant, and Mr. J. C. Hubbard (of Higman and Hubbard, St. Austell) was for the respondent company.

In the statement of claim the respondent alleged that the fatality was caused by accident arising out of and in the course of his employment, which was engine driving, but at the time of the accident he was repairing a carbide generator for use in the engine house, the explosion of which caused his death. The boy was earning £2 2s. a week, his father, mother, and four cousins being dependent on him.

In reply to the claim, the respondents denied that the carbide generator had anything to do with deceased's duties, that the father, mother, and four cousins were dependent on him, or that they were liable to pay compensation, alleging that the accident did not arise out of or in the course of his employment.

The Applicant's Case

In opening the case, Mr. Thomas said that the boy was aged 18, and the case really was whether or not the act of the boy arose out of, or was in the course of his employment. The boy was employed as engine driver in the engine room. The manner in which he met his death was that he was trying to work a carbide generator which he found in the engine house, and which exploded, causing considerable injury to the head and skull from which the boy died the same day.

In reply to the Judge, who desired information as to the principle of the generator, Mr. Thomas explained that the generator lamp in question had not been used for some time. It stood about a foot and a half high and had two compartments, the bottom one for carbide and the top one for water. The water dripping from the top compartment to the bottom—which was regulated by a tap—caused a gas to rise which was conveyed by a tube to a burner and gave the light. There was an oil lamp provided in the engine house for lighting purposes. Mr. Thomas went on to explain that the duty of the engine man was to regulate the winding of the trucks up the incline, their position being indicated on dials in the engine house, bells being rung at certain points of the operation. It was essential that there should be sufficient light for the man to see the indicator, and his case was that it was in consequence of the oil lamp giving insufficient light that the boy took the generator that had been lying in the house unused for years, to try to get it to give a better light. It was while doing this that it exploded and caused the boy's death. His submission was that it was a part of the duty of the engine man to see that he had sufficient light, and also to show that the oil lamp provided was insufficient. Mr. Thomas said candles often had to be resorted to for more light. In taking steps to improve the light so that he could the better discharge his duties, Mr. Thomas contended that the boy was acting within the scope of his employment and was thus entitled to compensation.

Father's Statement

The applicant, giving evidence, said that at the time he was captain of the clay works, but was now employed as a clay labourer at another company's works. He was in control of the works, and his boy was in charge of the engine house. At the time of the accident the boy was on afternoon shift, from 12.30 to 7, and during the time of his shift was in sole charge. There was only one hanging oil lamp in the engine house between the engine and the indicators, and it was about 18 ft. from the nearest indicator. His boy had never complained to him about the light, but a previous engine driver (William Richards) had complained to him about the lamp leaking, about two years before, and he had had it repaired. He was the first on the scene after the accident. The generator had been in the corner of the engine house unused for eight or ten years. The boy had power to get extra light if he wanted it.

Cross-examined, witness said that the accident happened about a quarter to one o'clock midday and admitted that there was at that time no urgency for extra light. He had been in charge of the works about seven or eight years. He had never received any complaint about the insufficiency of lighting in the engine house during the whole of that time and knew the generator had been lying idle in the engine house the whole of that time. He did not know the generator or how it was worked, but if it was dangerous it should not have been left there. He agreed that if left in an uncharged state it would not be dangerous, because he had frequently put things like spanners on it, as the generator was on a waste shelf. He had received no complaint from any engine man about the oil lamp except on the one occasion when it was leaking. The lamp had never given sufficient light.

Further Evidence

Sydney Arthur Davey, employed at the company's Trelavour Clay Works, but then employed at Western Works, said that he was in the engine house with Roy the evening previous to the accident when he was trying to get the oil lamp to burn. It would flare up and then go out. They then lit one of the candles in the engine house and he held it up so that Roy could see the working of the indicators. He was there about twenty minutes, leaving Roy there and the lighted candle on the seat beside him.

Cross-examined, he said that the boy could just see the indicators from the seat with the candle. If properly working, they could easily see the indicators with the oil lamp, but he did not consider the one oil lamp gave sufficient light.

John Henry Tucker, clay labourer, St. Dennis, in the employ of Goonvean China Clay Co., said that when he acted for nine months in the same engine house the lamp did not give sufficient light and he sometimes used a lighted candle in addition. Both parties admitted that the carbide used by the deceased for the generator was brought there by the boy and was not supplied by the company.

The Defence

Captain Fred Lobb, superintending foreman of the company's works, said he visited all the works of the company nearly every day to advise the individual foreman as to the management of the works, including engine house and machinery. He had never received any complaint about this engine house. A double burner oil lamp (produced) was used in the engine house. He had been captain, or superintendent captain, for over twenty years. He considered the lamp was sufficient for the purposes required. It was the type of lamp used in all engine rooms with which he was familiar. The generator was complete, minus the burners and tubes. He had seen the carbide lamp in use in the bottom of the clay pit for which it was originally purchased and it gave a brilliant light. It would have been too strong a light for the engine room. It had not been used since 1914 and was used in the engine room. If any engine man had asked to be allowed to use it, he would not have allowed it in the engine room. It was not a part of the engine man's duties to try to improve the lighting of the engine house. If there was an insufficiency of light, it was the duty of the engine man to report to the captain in charge or to him, and they had done so about other things. He was not aware that candles had been used in the engine house and they had never been supplied for that purpose. Cross-examined, he said that the works captain had never complained to him about the light. He had worked for five years in the same engine room under the same condition twenty years ago, with a double burner lamp similar to the one in use at the time of the accident. He admitted that the engine man was in charge of the lights, but if the light provided was not sufficient it was the place of the engine man to report it. He had no right to procure some other sort of light on his own responsibility.

Frederick Wagner, local manager of the company, said that he had never received a request to supply new or additional lighting for this engine house or had any complaint about the

insufficiency of light. It would have been necessary for him to have been informed of any prospective purchases.

Judgment Reserved

Mr. Hubbard, in closing the defence, said the issue was whether it was a part of the duty of the boy to introduce another kind of light and whether what he did was in the course of his employment. Even if there was insufficient light, which he did not admit, it would not justify the boy in trying to get another light. What was really behind it was that the boy had a mechanical bent and took the generator to experiment with. He might have thought it would be a good thing to supplement the existing light, but that did not entitle the applicant to bring the case within the scope of the Workmen's Compensation Act.

His Honour said it would be necessary for him to look up legal decisions on the issue raised by the case and he reserved judgment, which he promised to deliver at the October Court.

A Survey of China Clay Production

Mr. J. G. W. James at St. Austell

MR. J. G. W. JAMES, general secretary of the Pottery and Glass Trades Benevolent Institution, recently paid a special visit to St. Austell in connection with the Institution's scheme for providing instruction and examination in salesmanship in the pottery and glass industries.

He visited the Hendra China Clay mine near St. Dennis, by the courtesy of English China Clay, Ltd., and was conducted round the works by Captain D. Yelland. At the new pit powerful hoses were in operation for removing the crude clay and the water quickly carried away the clay as it was washed from the sides of the pit. Stone, mica, and refuse are also washed down. Sand and other extraneous matter is trapped in the sand-drags and the clay flows on to the sump, whence it is pumped to the surface. The sand-drags are so constructed that the tram wagons can load underneath without much shovelling. When full the wagons are drawn to the peaks on the surface and tipped automatically. The overburthen at Hendra is largely peat.

After seeing China Clay in its initial stages Mr. James was shown the refining micas with automatic traps which showed how the clay entered—first into a deep round head, and was then distributed into a long series of refining channels, and thence into the settling pits; the quality and quantity of clay washed is ascertained hourly and small round samples are obtained and despatched to the head office daily. The filter press is composed of a series of trays each having a cloth-bag or lining. Clay is pumped into these bags by hydraulic pressure through taps and nozzles at the top. Pressure is continued until the greater part of the water is squeezed out, leaving the clay in a plastic state in the bags. At each operation about 30 cwt. of clay is pressed. The clay is then directed by conveyor to the kiln in one long length and after passing an automatic cutter is distributed in the drying pan for the final elimination of moisture. The kilns are specially constructed for the miniature railway which the firm have laid down from the works to Drinnick-Mill Station on the Great Western Branch.

No Market for Building Stone

From Hendra Clay Works Mr. James went to the Hendra China Stone Quarries where, through the kindness of Mr. John Lovering, J.P., principal of John Lovering and Co., Mr. James saw the processes in China Stone, which are very different from China Clay production. Captain Fred Stephens, works superintendent, explained the engine house where the firm have installed engines for pumping, hauling and producing compressed air for the boring machines. The pit at Hendra Quarries is several hundred feet deep and there are three classes of stone produced. Buff is found from 15 ft. to 20 ft. down; white and mild purple deeper, and the very best, or hard purple, is found about 150 ft. from the surface. There is a good market for the stone, large quantities going to America and Staffordshire, and the firm has an annual output of 8,000 tons. The works are capable of doing 12,000 tons per annum, but there is no market now for the large quantities of building stone raised, since the introduction of concrete blocks, and much is dumped in large heaps surrounding the pit.

Impurities in China Clay

Importance of Chemical Purification

MANUFACTURERS are insisting more and more on the purity of the materials they employ in their processes of manufacture, and the producers who can guarantee the highest degree of purity stand the best chance of selling their commodities.

The Presence of Iron

One of the chief impurities with which the producers of China Clay are concerned is iron. For paper and textile manufacture the whitest clays are of the greatest value, and for the production of white China Clay there must be a white clay bed and an abundance of pure water. Water which may appear clear and pure to the eye, however, may contain enough iron salts in solution and colloidal iron compounds in suspension to reduce greatly the value of the clay it washes, in such a way that the clay which is white in the pit or quarry assumes, during the washing and refining, a creamy or yellowish tint. Iron betrays its presence in the water by coating the ground over which it flows with a red film of iron hydroxide. It exists in the water as colloidal iron hydroxide. The iron is partly precipitated by exposure to the atmosphere and partly by the action of substances which the water dissolves as it flows through the crevices or fissures in the veins or lodes in the clay bed, or as it flows along the ground. The precipitation may, however, be incomplete because colloids are notoriously reluctant to conform with the established laws of chemistry, and their coagulation and precipitation is usually slow and uncertain. As any iron not precipitated tends to come down with the clay particles, the iron must be removed before the stream is used for washing, as otherwise the clay will be darkened in colour.

There are various methods that have been adopted in other industries in other countries for removing the iron from the water, but until recently but few clay producers had tackled the question scientifically. It is reported that Mr. Edward J. Hancock and his associates have adopted with success a simple process for precipitating the iron content of the water, and more may be expected to be heard of this later.

Settlement in Wales

It is common experience that China Clay does not settle as quickly in perfectly fresh, clear spring water or rain water, as it does in water which has already been used for washing and returned from the settling pits to the mine to be used again for the same purpose. Clay settles more quickly in water which has been returned or "repeated" from the settling pits, probably owing to the presence in this water of dissolved salts, which act in the same way as alum. A small proportion of China Clay is nearly colloidal. Colloids remain in suspension in water an indefinite time, and are coagulated and settled by electrolytes, of which alum is one of the most efficient.

Variation in Quality

A clay obtained from near the top of the mine differs from that obtained from the bottom of the mine in many ways. Top clay is usually stained with impurities, dissolved by the water which percolates from the surface of the ground through the subsoil or overburden to the clay bed, and deposited on the clay. It is also found that top clay does not settle as quickly as bottom clay, and water repeated from the settling pits to be used again for washing generally contains a large amount of clay in suspension. Bottom clay, on the other hand, behaves normally and settles comparatively easily. The cause of the settling of top clay is uncertain, but it would appear that, being more exposed to outside influences than bottom clay, it has been weathered and is in a more advanced state of change, decomposition, or weathering. Clay being fairly impervious to water, the percolating water would affect to a much greater extent clay near the surface of the ground than clay situated 100 ft. or more below the surface. The particles of top clay are finer in grain than those of bottom clay, and it is in the so-called top clay that iron is most frequently encountered.

Water may also contain organic matter in solution which will darken a clay. This is not so serious a matter as iron. If the value of a clay depends entirely on its colour in the raw state after leaving the kiln, the presence of organic matter is detrimental, but if its value depends on its potting or firing

qualities, the presence of organic matter may be immaterial. Organic substances are oxidised to carbon dioxide during the heating of the clay in the potter's oven. It is even said that for potting purposes, the presence of organic matter may be more a help than a hindrance.

A perfect China Clay should, however, be as nearly as possible free from organic matter and iron, and the producer who can supply the market with the purest clay will command the greatest sale at the highest price. Hence the necessity of the scientific study of the question of iron precipitation and the removal of other impurities from the washing stream.

E. J. L.

Raw Materials for Sanitary Ware

Use of Clay, Flint, and Feldspar

In the course of an interesting paper presented at the annual meeting of the American Ceramic Society, Mr. W. H. Darrah described the processes in the manufacture of vitreous sanitary ware, including closets, tanks, and lavatories. His remarks on the selection of the raw materials and their treatment should prove interesting to China Clay, ball clay, feldspar and china stone producers.

The raw materials, he said, consisted primarily of clay, flint, feldspar, and the glaze materials, such as borax, silica, whiting and oxides of various materials, such as tin, lead, zinc, etc. Clay, flint, and feldspar were used in relatively large quantities, since the average slip might be said to be composed roughly of 50 per cent. clay, 25 per cent. flint, and 25 per cent. feldspar. The above should not be considered as a working formula, as many factors had to be taken into account, but the proportions mentioned gave a broad perspective of the quantities of the various materials employed. To obtain the most satisfactory working conditions, the clay, flint, feldspar, and related products had to be unloaded from the cars into suitable storage bins, which should preferably hold at least 60 days' working supply. Supplies of fire clay and material for making saggers and other refractory pieces, must also be stocked in working quantities. Many of the higher grade clays might be purchased in a ground, pulverised condition, while the ball clay and cheaper products were handled in the bulk or semi-raw state. A surprisingly large proportion of the clays used in the sanitary ware industry to-day were either imported from England or carried a long way. While the cost of raw materials was not a large factor in the manufacture of this ware, there was at present considerable room for economy by the wider use of native clays in various localities. This involved some development, but certainly no insurmountable problems.

The clays, flint, and feldspar and other materials, were best collected from the bins by the sliphouse man in a scale car running along a narrow gauge track in front of the doors of the various bins. In the speaker's opinion a relatively intelligent man should be in charge of this process, as accuracy in scaling the various materials would well repay the expense involved by maintaining uniformity and reducing losses in the various manufacturing operations and in the finished product.

Blunging Operations

The blunging operation was one of considerable importance, and must be allowed ample time to insure a thorough mixing of all the materials and the production of a uniform, thin slip. Blungers for operations of this kind should preferably be free from exposed iron, and either lined with tile or ceramic materials. Wooden linings might be employed, but the depreciation and wear were quite rapid, and the particles of the wood which were worn away of course entered the slip and, occasionally, caused trouble later in the manufacturing process. Blunging was continued for a period ranging from one to eight hours, depending on the nature of the raw materials employed. Four or five hours represented a common condition. In some exceptional cases a longer time was necessary. It was advisable to take all precautions to see that no grease, oil, or foreign materials entered the slip from the blunger or accessory machinery. After the completion of the blunging period the slip was passed beneath an electro-magnet through a lawn, thus removing magnetic particles and lumps, pebbles, etc., which would, of course, be detrimental to the ware. A 120-mesh lawn was well suited for this preliminary step.

The slip, after passing through the lawn, was divided into two portions, one of which was returned to the slip blunger, while the balance was passed to a filter press, which reduced the moisture to 30 or 40 per cent. The filter cakes from the press were then added in the proper proportion to the slip in the second blunger, together with the proper amount of electrolyte, and the mixture was blunged for a second time.

The Electrolyte

A number of materials were used for the electrolyte, but as a result of an extensive series of tests, it appeared that a mixture of approximately equal parts of sodium silicate and sodium carbonate gave very satisfactory and quite uniform results. The amount of these combined materials varied with the nature and character of the materials used in making the slip. It had been developed by careful experimental work that the hydrogen ion content of the clay, as well as the fineness and chemical composition, very largely determined the quantity of electrolyte necessary. From ·25 per cent. to ·5 per cent. represented a common condition, and, as a rule, the proper quantities were determined by practical tests rather than on a theoretical basis.

After the completion of the second blunging, the slip, which contained from 25 to 30 per cent. water, was passed under a second magnet and through a second lawn, which usually ran about 90 mesh to the inch. The slip was then stored in the slip tank, where it was kept in continuous agitation until used.

Oil Fael versus Coal

Advantages Claimed

Recent references have been made to the efforts of China Clay producers for the reduction of production costs in the direction of filter presses in connection with the drying process and electricity for power purposes. A third economy quest is in the appplication of fuel oil to the drying kilns instead of coal for drying the clay after the bulk of the moisture has been eliminated by the filter press plant. As yet the fuel oil method of producing the necessary heat in the kilns is in its infancy, but in the one or two cases in which it has been tried the experimenters have expressed themselves pleased with the results. As China Clay producers are of an inquisitive turn of mind so far as new economy-seeking methods are concerned, they will be interested in the following advantages that are claimed in favour of oil fuel.

The *calorific value* of fuel oil is about 18,900 B.T.U. per lb. as compared with coal, which usually varies between 11,500 and 14,500 B.T.U. per lb., according to the nature and quality of the coal. There is therefore an increase of from 30 to 64 per cent. in the heating value of oil as compared with coal, weight for weight.

The *thermal efficiency* of an oil-fired boiler is much higher than that obtained with coal-firing, as there is perfect smokeless combustion. The efficiency of the great majority of coal-fired boilers in this country, under average working conditions, does not exceed 65 per cent., whereas experience with oil-firing shows that 80 per cent., and sometimes more, of the theoretical heat value of the fuel is recovered under normal conditions. The ratio of heat units utilised per pound of oil fuel, when compared with coal, taking into account the higher calorific value and better thermal efficiency, is as follows :—

	Coal.	Oil.
1. *For Steam Raising :*		
With coal of 14,500 B.T.U.	1	1½
With coal of 11,500 B.T.U.	1	2
2. *For Industrial Furnaces :*		
Billet heating, with coal or coke of 11,000 B.T.U.	1	6

The heating value of coal varies over a wide range, and is further often depreciated by the absorption of moisture, by frequent handling, turning a lot of the coal into dust, and by losses through the fire-bars of furnaces. On the other hand oil possesses a *constant heating value* which seldom varies from specification, and this constant uniformity is true of deliveries made in all parts of the world.

It will be seen from the above that the quantity of fuel required to do the same work is much less with oil than with coal, consequently there is great *saving of space* in storage of fuel. There is a further advantage, that while oil maintains its calorific value indefinitely, coal steadily depreciates in thermal value in the course of time.

With fuel oil furnaces the labour required for stoking, cleaning fires, and handling ashes is eliminated, effecting a great *reduction in the cost of labour*, which is one of the important

factors to be noted in comparing the respective fuels. In London to-day firemen are reckoned at £4 10s. per week and ash disposal 7s. 6d. to 15s. per ton, some coals giving off as much as 30 per cent. ash. An oil-fired furnace rapidly attains its maximum heat from cold and is easily maintained at full capacity for prolonged periods. It can be instantly shut off when not required, and stand-by losses are accordingly avoided.

The *perfect combustion* readily obtained with oil fuel means absence of smoke, soot and clinker and subsequent disposal of same. Oil can be pumped into storage with great rapidity and an absence of the dirt, trouble, and labour associated with handling coal.

The Cornish Band Competition

Annual Festivities in the China Clay Industry

SIXTEEN bands, and 44 separate performances, lasting from noon to 8.30 p.m. before a crowd of over 7,000 people, were the main features of the ninth annual West of England Bandsmen's Festival, at Bugle last month. The festival is generously supported by China Clay producers, and is looked upon by the clayworkers as an annual holiday. This year the speculative element was more in evidence on account of the attendance of bands outside the county which had not competed before. These bands were from Yorkshire, Wales, and Plymouth.

A new feature of the prize list was the offer for the first time for competition of the Cornish ladies' silver challenge cup, value 75 guineas, open to any band, together with a cash prize of £30 for the champion band. The fund for this was organised by Mrs. Horton Bolitho, Mrs. Charles Hext, and Mrs. J. de C. Treffry.

The organisers were particularly gratified by the presence of Sir Walter Peacock, K.C.V.O., secretary of the Duchy office, who originally brought the objects of the festival to the notice of the Prince of Wales, and led to His Royal Highness presenting to the Committee the handsome challenge cup, which is the outstanding trophy among a host of beautiful trophies offered for annual competition.

Kingswood Evangel (Bristol) were last year's champions, St. Dennis had been four times champions before that, and Camborne before St. Dennis. Since the last festival, a set of silver medals had been presented by the Prince of Wales to St. Dennis in recognition of their repeated successes. The test piece was *Grand Selection* from *Euryanthe* (Weber).

The winners were—1, Camborne, taking the Prince of Wales's, Cornish Ladies', and the Cornish championship silver cups, a silver-plated cornet and £50 cash prizes; (2) Oakdale Colliery, taking the *Western Morning News* silver trophy and a triply silver-plated tenor horn, and cash £20; (3) Carlton Main, taking the silver-mounted baton and £15; (4) St. Dennis, taking South Australian Cornish Association's challenge vase, with a silver medal for the resident bandmaster, and a triply-plated "soloist's" instrument; (5) Kingswood.

China Clay Band's Success

The championship of the smaller bands went to a China Clay workers' band—Stenalees. The order was: selection, *Songs of Ireland* (H. Round), for second section championship, (1) Stenalees, taking the President's, Sir Edward Nicholl's, silver challenge shield, cash prize £20, and conductor's frock coat uniform to bandmaster; (2) St. Blazey and District, taking Hawke's challenge shield and £15; (3) Greensplatt, taking silver-plated conductor's music stand and £12; (4) Falmouth Town, prize £8; (5) St. Ives Town, prize £5. This band also took Mr. D. George Collin's challenge shield and a cash prize of £5 awarded to the band not in the first four.

Mr. J. Hooper, one of the Vice-Presidents, a China Clay worker, and a keen supporter of St. Dennis band, presided at the presentation of the prizes.

Mr. Bennett, one of the judges, said that the bands in Cornwall should be very grateful that such a festival had been brought to their doors. He had not seen anything like the arrangements, or the value in prizes. They were more than honoured in claiming the interest of the Prince of Wales, and were honoured in having Sir Walter Peacock, the secretary of the Duchy, to distribute the prizes.

In welcoming Sir Walter Peacock, Mr. J. Hooper said that Sir Walter had done so much for Cornish bands, and they hoped he would be able to influence the Prince to honour the festival with his presence next year.

In a vote of thanks, Mrs. Horton Bolitho announced that Sir Charles Cottier had very kindly promised to give a silver cup to be competed for next year, and to be awarded to the band which showed the best deportment and equipment.

August Deliveries of China Clay

A Seasonal Decrease

OWING to the Bank Holiday and suspension of work at Fowey jetties for the regattas, an increase in tonnage was not expected in August. A drop of under 4,000 tons from the July total is not surprising. China Clay was down by less than a thousand tons, china stone by over 2,000 tons, and ball clay by less than 60 tons.

The total trade done in all classes for the eight months has been 626,365 tons, against 585,607 tons for the corresponding period last year, a net increase of 40,758 tons. The deliveries of China Clay have not only been responsible for the whole of this increase but for nearly 8,000 tons besides, there having been a decrease to this extent in the china stone and ball clay deliveries during that period. China Clay showed a total increase of 48,319 tons, china stone a drop of 1,910 tons, and ball clay a drop of 6,661.

The following are the details for August, and the totals for the previous seven months:—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total Tons.	
Port.	1925.	1924.	1925.	1924.	1925.	1924.	1925.	1924.
Fowey.....	48,508	46,693	3,531	4,749	2,720	1,500	54,759	52,942
Falmouth..	110	—	—	—	—	—	110	—
Penzance ..	2,500	—	—	—	—	—	2,500	—
Newham...	190	—	—	442	—	—	190	442
Plymouth..	1,490	956	31	—	—	470	1,521	1,426
Par	3,832	4,360	570	818	—	—	4,402	5,178
Charlestown	5,904	1,105	—	—	—	—	5,904	5,105
Hayle	—	240	—	—	—	—	—	240
	62,534	57,354	4,132	6,009	2,720	1,970	69,386	65,333
By rail	3,650	4,327	—	—	—	—	3,650	4,327
	66,184	61,681	4,132	6,009	2,720	1,970	73,036	69,660
July	67,032	68,951	6,561	5,347	2,787	8,005	77,390	82,303
June	69,022	58,504	3,830	3,310	2,619	3,076	75,471	64,890
May	80,860	82,405	4,286	3,363	1,825	2,859	86,671	88,357
April	59,624	75,311	3,198	44,651	1,118	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February ..	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January ...	74,490	56,686	2,056	3,978	3,050	1,567	80,046	62,231
Total eight months	578,292	529,973	30,475	32,385	16,588	23,249	626,365	585,607

China Clay Exports for August

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination, registered during the month ended August 31, 1925:—

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Finland	903	1,010
Esthonia	528	515
Sweden	3,874	6,051
Norway	2,129	2,781
Denmark	546	1,932
Germany	1,469	3,107
Netherlands	5,381	10,410
Belgium	4,340	7,140
France	1,819	3,167
Switzerland	47	113
Portugal	15	60
Spain	1,462	2,519
Italy	1,123	2,646
United States of America	18,582	33,551
Mexico	145	580
Peru	5	20
Chile	30	131
Brazil	5	23
Bombay via other Ports	1,194	4,845
Madras	95	380
Bengal	326	1,302
Australia	77	396
New Zealand	1	8
Canada	282	783
Total	44,378	83,470

China Clay Notes and News

Sale of China Stone Quarry

A China stone quarry, offered for sale by auction at St. Dennis, was withdrawn by the auctioneers, Herbert Rowse and Son, St. Austell, but was subsequently sold privately to Mr. Rich, Cardynham, Bodmin, at a price that was not disclosed.

China Clay Merchant's Gift

Mr. C. V. Rowe, of the Wheal Prosper China Clay Co., Ltd., who has on many occasions shown his great interest in the Workers' Institute at Roche, has kindly offered to place a lamp at the entrance to the Institute. This will not only be a benefit to the recipients, but will light up one of the dark corners of the village.

Fowey's Rates and Revenue

The general district rate for Fowey in the ensuing six months is to be 2s. 8d., against 2s. 10d. for the last half-year. The ancient borough derives good revenue from the jetties and town quay in the form of charges for water to vessels and of tolls from users of the quay. In July the revenue from the jetties was over £106 and from the town quay and markets over £27.

English China Clays, Ltd., Dividend

The directors of English China Clays, Ltd., announce an interim dividend on the ordinary shares at the rate of 4 per cent. per annum for the half-year ended June 30, 1925, to be paid on October 1 to ordinary shareholders registered on September 17. The interim dividends for each of the two preceding years were at the same rate, the final dividends on each occasion being 2½ per cent., actual, making therefore 4½ per cent.

Successful Hospital Fete at St. Austell

Great success again attended the annual fête in aid of the St. Austell Cottage Hospital last month, when over £450 gross receipts were realised. The China Clay producers and workers are strong supporters of the Hospital, which has recently been enlarged to 24 beds. Mr. H. Stocker, as hon. treasurer, and Mr. G. H. Grenfell, hon. secretary, take keen interest in its control and management. Mr. E. B. Vian, who is also associated with English China Clays, Ltd., is the chairman of the committee.

China Clay Merchants and Sport

China Clay producers take a keen interest in the sporting activities of the clay workers and of the China Clay district generally. Mr. J. W. Higman has recently accepted the presidency of the St. Austell District Wrestling Association, which recently organised the championship tournament at St. Austell. Mr. Walter Sessions has become president of the St. Austell Football Supporters' Club, which arranged a successful boxing tournament in the Public Rooms, St. Austell, on September 5. Frank Radcliffe, a St. Austell boy, retained the feather-weight championship of Cornwall. Frankie Ash, of Plymouth, fly-weight champion of England, gave interesting exhibition bouts. Mr. Sessions said that they were out to develop more interest in boxing, and hoped by such exhibitions to attract increased attention to the sport.

China Clay in U.S.A.

Steps have been taken to fight the efforts being made to increase by 50 per cent. the duty on English clay, following a special meeting of paper manufacturers and clay importers at the Waldorf-Astoria hotel in New York City. The clay importers were represented by their Clay Import Committee. Although the principal organised effort against the proposed increase has come from the paper manufacturers and the clay importers, steps also are being taken by the manufacturers of dinnerware, sanitary ware, and tiles to join these makers, all of whom have much in common when the clay question is considered. The unsuitability of domestic clays for purposes which require clays not to be found in the U.S.A. are met with in all of these industries, and particularly in the manufacture of dinnerware many makers state that English clay is absolutely essential to obtain certain qualities.

Clay-Worker's Fatal Short Cut

Through taking a short cut to his work, Thomas George Gerrey, aged 47, of Tregonissey, St. Austell, in the employ of H. D. Pochin and Co., Ltd., at their Gunheath Works, was killed on the G.W.R. Mineral line. He had been employed at the works some years. The facts of the accident were disclosed at the inquest.

Frederick Julyan, employed at the same works, said he left the works to go hone at 3 p.m. He had gone about 200 yards from the works, and was walking on the burrow at the side of the railway line and saw Gerrey lying in the middle of the track. He went to him and heard him breathing, and went for help. Gerrey was eventually removed to the works office. It was a very rough day, windy and raining. There were marks in the middle of the track, extending from where the body was found for about 40 ft. or 50 ft. in the direction of Bugle.

Evidence was offered to the effect that the men had been warned repeatedly that they were not to walk on the line. The jury returned a verdict of accidental death, caused by his being knocked down by a locomotive whilst trespassing on the railway line. The driver was exonerated from all blame.

Fowey Jetty-Men Retain Rowing Championship

Fowey Regatta was held last month. The ships in the harbour were gaily decorated, and the crowded boats on the flanks of the course presented a gay scene, while crowds watched the events from points of vantage on both the Fowey and Bodinnick and Polruan sides of the estuary. The four-oared races afforded the most entertainment, especially the challenge race for the championship of the port of Fowey, for which there is always great rivalry to win Sir Arthur Quiller-Couch's trophy—a silver challenge cup. The challenge race for four-oared boats, not exceeding 18 ft. long and 5 ft. 6 in. beam, was contested by four boats, but *Defender* gave up after going less than half the course *Docker* 2 shot well ahead at the start and kept a good lead throughout, and finished several lengths ahead of *Challenge*, which was second, and *Defiance* third, several lengths behind. The course was over three miles. The regatta was well supported by China Clay merchants, shipbrokers, and others connected with the port of Fowey.

The arrangements were successfully carried out by a committee of which Mr. T. E. G. Barnicutt (of the harbour master's office) was the hon secretary, and Mr. J. A. S. Strong the hon. treasurer. The president was Mr. George Varco (Mayor of Fowey), and Mr. R. Vincent was the active chairman of committee.

Back to Cornwall

There is no more delightful experience than to return to Cornwall after an absence of some time—especially if you are a Cornishman—writes a visitor back from a holiday. The feeling resists analysis. Whether it is the air, the sight of the old familiar clay, or the heather-covered moors I know not. It may, perhaps, be the lure of the cream or the rich Cornish dialect, which, unfortunately, seems to be slowly disappearing. Anyway, it was with a feeling of exquisite joy and pleasure that I stretched my limbs on those delightful downs which lie just above St. Austell. I had brought a novel with me, but I soon put it on one side. It seemed out of place amid those weather-worn boulders and the gorse and the heather. The sun was high up in the clear sky, the air was extraordinarily clear, and I could see the surrounding country for miles around. There, on my right, was the sea, with the Eddystone Lighthouse on the distant horizon. Below me was the village of Bugle, surrounded by those clay sand hills which are so reminiscent of my home country. Just 200 yards away was the white road along which thundered and rattled the Great Western 'bus, leaving behind it a trail of white dust. A few minutes later a clay waggon lumbered along with its load of white, and its complacent driver in his blue-striped shirt and corduroy trousers. He has a cheery word for everyone, from the rosy-faced children playing in the road to "the stranger within the gate." It is a happy custom Cornish people have—that of exchanging a greeting with all and sundry. One may well feel lonely in London, with its busy, teeming millions, but in Cornwall everyone seems to be friendly.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—August, 1925

Arrival. Date.	Name.	Sailing Date.	Destination.
Aug. 1,	S.V. *Antelope*	Aug. 5,	Copenhagen
Aug. 3,	*Jade*	Aug. 8,	Hamburg
Aug. 3,	S.S. *Hayle*	Aug. 4,	Preston
Aug. 3,	S.S. *Blush Rose*	Aug. 5,	Ridham
Aug. 4,	S.S. *Wheatplain*	Aug. 7,	Terneuzen
Aug. 4,	*Helena Anna*	Aug. 6,	Charlestown
Aug. 4,	S.S. *Avanville*	Aug. 7,	Preston
Aug. 4,	S.S. *Estella*	Aug. 11,	Antwerp
Aug. 4,	S.S. *Kentish Coast*	Aug. 7,	Liverpool
Aug. 5,	S.S. *Pansy*	Aug. 7,	Ridham
Aug. 6,	S.S. *Slateford*	Aug. 11,	Gravesend
Aug. 6,	S.S. *River Fisher*	Aug. 11,	Preston
Aug. 6,	S.S. *Broadgreen*	Aug. 12,	Bilbao
Aug. 6,	S.S. *Vechtstroom*	Aug. 8,	Amsterdam
Aug. 7,	S.S. *Majfrid*	Aug. 14,	Kotka
Aug. 7,	*Valonia*	Aug. 20,	Dartford
Aug. 8,	S.S. *Signfred*	Aug. 13,	Gefle
Aug. 8,	M.V. *Intrepido*	Aug. 19,	Genoa
Aug. 8,	S.S. *Gouwestroom*	Aug. 13,	Amsterdam
Aug. 9,	S.S. *Florentino*	Aug. 12,	Genoa
Aug. 9,	M.V. *Mayblossom*	Aug. 11,	Looe
Aug. 9,	*Helena Anna*	Aug. 15,	London
Aug. 9,	M.V. *Jenny Naval*	Aug. 15,	Hamburg
Aug. 10,	S.S. *Wearbridge*	Aug. 21,	Philadelphia
Aug. 10,	S.S. *Hayle*	Aug. 15,	Ridham
Aug. 11,	S.S. *Farfield*	Aug. 14,	Grimsby
Aug. 11,	S.S. *Cornish Merchant*	Aug. 15,	Rouen
Aug. 11,	S.S. *Bangor*	Aug. 15,	London
Aug. 11,	S.S. *Steinstad*	Aug. 18,	Boston
Aug. 11,	S.S. *Orchis*	Aug. 15,	Rouen
Aug. 12,	M.V. *Mayblossom*	Aug. 13,	Pentewan
Aug. 13,	*Louise*	Aug. 29,	Runcorn
Aug. 13,	S.S. *Rubfred*	Aug. 20,	Norrkoping
Aug. 13,	S.S. *Ellen Larsen*	Aug. 21,	Kotka
Aug. 13,	S.S. *Shoreham*	Aug. 19,	Weston Point
Aug. 13,	S.S. *Lisbeth Cords*	Aug. 20,	Brussels
Aug. 13,	S.S. *Maggie A.*	Aug. 21,	Rochester
Aug. 13,	M.V. *Britta*	Aug. 24,	Christiansand
Aug. 13,	S.S. *Foamville*	Aug. 22,	Glasson Dock
Aug. 15,	S.S. *Dagfrid*	Aug. 25,	Trungsund
Aug. 16,	S.S. *Allanwater*	Aug. 20,	Liverpool
Aug. 16,	S.S. *Waterwitch*	*	Newcastle
Aug. 17,	S.S. *Ferndene*	Aug. 23,	Hamburg
Aug. 17,	*W. E. Gladstone*	Aug. 18,	Pentewan
Aug. 17,	S.S. *System*	Aug. 19,	Tayport
Aug. 17,	S.S. *Katherine*	Aug. 14,	Plymouth
Aug. 17,	S.S. *Falmouth Castle*	Aug. 20,	Runcorn
Aug. 17,	S.S. *Pylades*	Aug. 21,	Bo'ness
Aug. 17,	S.S. *Cornish Trader*	Aug. 22,	Antwerp
Aug. 19,	M.V. *Steiermark*	Aug. 29,	Harburg
Aug. 19,	S.S. *Monksville*	Aug. 24,	Weston Point
Aug. 20,	S.S. *Alice*	Aug. 26,	Weston Point
Aug. 20,	S.S. *Citrine*	Aug. 27,	Harburg
Aug. 20,	S.S. *Hagfors*	Aug. 21,	Gothenburg
Aug. 20,	S.S. *Gunhild*	Aug. 21,	Wargen
Aug. 21,	S.S. *Mersey*	Aug. 22,	Rouen
Aug. 21,	M.V. *Shamrock*	Aug. 21,	Plymouth
Aug. 21,	M.V. *Ilmater*	Aug. 26,	Reval
Aug. 21,	*Flying Foam*	Aug. 22,	Par
Aug. 21,	S.S. *Katherine*	Aug. 24,	Pentewan
Aug. 21,	S.S. *Blush Rose*	Aug. 26,	Preston
Aug. 21,	S.S. *Ylva*	Aug. 27,	Oscarsham
Aug. 23,	S.S. *Baron Elcho*	Aug. 31,	Portland Me.
Aug. 23,	S.S. *Gunver*	Aug. 28,	Genoa
Aug. 23,	S.S. *Wheatcrop*	Aug. 27,	Larne
Aug. 24,	S.S. *Tarnwater*	Aug. 28,	Preston
Aug. 24,	S.S. *Pacific Maru*	Sept. 7,	Philadelphia
Aug. 24,	M.V. *Mayblossom*	Aug. 25,	Looe
Aug. 25,	S.S. *Tynebridge*	*	Portland Me.
Aug. 25,	M.V. *Shamrock*	Aug. 25,	Plymouth
Aug. 25,	S.S. *Guelder Rose*	Aug. 27,	Hull
Aug. 25,	S.S. *Clydeburn*	Sept. 1,	Rouen
Aug. 25,	S.S. *Lilly*	Aug. 29,	Antwerp
Aug. 26,	*Mary Ann*	*	Garston
Aug. 26,	S.S. *Cervantes*	Aug. 27,	Genoa
Aug. 26,	S.S. *Redesmere*	Aug. 28,	Liverpool
Aug. 27,	S.S. *Edern*	Aug. 31,	Antwerp
Aug. 27,	S.S. *Primrose*	Sept. 1,	Runcorn
Aug. 27,	M.V. *Diligent*	Aug. 28,	Mevagissey
Aug. 28,	M.V. *Monsun*	Sept. 2,	Antwerp
Aug. 28,	S.S. *Runnelstone*	Sept. 2,	Brussels
Aug. 28,	S.S. *Clara Monks*	Sept. 2,	Leith
Aug. 28,	S.S. *Vechtstroom*	Sept. 3,	Amsterdam
Aug. 29,	S.S. *Falmouth Castle*	Sept. 2,	Weston Point
Aug. 30,	M.V. *Triumph*	Sept. 2,	Plymouth
Aug. 30,	S.S. *Gouwestroom*	Sept. 5,	Amsterdam
Aug. 30,	S.S. *Marga*	*	River Plate
Aug. 31,	S.S. *Blush Rose*	Sept. 3,	Ridham

* In port.

Charlestown Shipping—August, 1925

Arrivals

Date.	Vessel.	From
August 4	*Guiding Star*	Falmouth
August 4	*Verta*	Torquay
August 4	*Lady Daphne*	Falmouth
August 5	*Maralie*	Plymouth
August 6	*La Revanche*	Plymouth
August 6	*Helena Anna*	Fowey
August 7	*Grosvenor*	Plymouth
August 7	*River Humber*	Cowes
August 7	*Leif*	Danzig
August 8	*Conrad Luhring*	Wyborg
August 13	*Naiad*	Par
August 15	*Isabella*	Dartmouth
August 18	*Treleigh*	Portreath
August 18	*Louistic*	Cardiff
August 18	*My Lady*	Falmouth
August 18	*Penryn*	Falmouth
August 19	*Adam Smith*	Hayle
August 20	*Nalan*	Shoreham
August 20	*Porthleven*	Swansea
August 22	*Ruth*	Cardiff
August 23	*Vera*	Yxpila(Finland)
August 26	*Amy*	Falmouth
August 27	*Robrix*	Plymouth

Sailings

Date.	Vessel.	Destination.
August 4	*Guiding Star*	Western Point
August 5	*Maralie*	London
August 6	*La Revanche*	Nantes
August 6	*Helena Anna*	London
August 6	*Ryelands*	Rochester
August 6	*Robrix*	London
August 7	*Grosvenor*	Fleetwood
August 7	*Confidence*	Drammen
August 8	*Venta*	Rochester
August 8	*Lady Daphne*	Rochester
August 10	*River Humber*	Preston
August 11	*Zeehord*	Terneuzen
August 18	*Treleigh*	Preston
August 19	*Leif*	Gothenburg
August 19	*Naiad*	Northfleet
August 19	*Isabella*	Western Point
August 20	*My Lady*	Goole
August 20	*Adam Smith*	Barrow
August 21	*Nalan*	Brussels
August 22	*Penryn*	Rochester
August 22	*Porthleven*	Gravesend
August 22	*Conrad Luhring*	Rono (Finland
August 24	*Louistic*	Nantes
August 30	*Robrix*	London
August 30	*Amy*	Rochester

Par Harbour Shipping—August, 1925

Arrivals

Date.	Vessel.	From
August 1	S.S. *Tanny*	Penryn
August 2	S.S. *Queenie*	Llanelly
August 3	M.V. *Hauker*	Kami
August 4	S.V. *Lord Devon*	Looe
August 5	S.S. *Treleigh*	Portreath
August 5	S.V. *Two Sisters*	Falmouth
August 5	M.V. *Regina*	Plymouth
August 5	S.S. *Magrix*	Teignmouth
August 7	M.V. *Maggie Annie*	Falmouth
August 7	S.V. *Henrietta*	Blyth
August 8	S.V. *Naiad*	London
August 10	S.V. *Volant*	Mevagissey
August 11	S.V. *Hero*	Falmouth
August 11	S.V. *Snowflake*	Mevagissey

August 15	S.V.	*C. F. H.*	Newlyn
August 16	M.V.	*Katie*	Exmouth
August 16	S.S.	*Robrix*	Teignmouth
August 17	S.V.	*Hector Cundy*	Penzance
August 18	S.V.	*Pedestrian*	London
August 18	S.S.	*Tanny*	Penryn
August 19	S.S.	*Drumlough*	Penryn
August 20	S.V.	*Winifred*	Plymouth
August 20	S.V.	*Alzina*	Plymouth
August 21	S.S.	*Tanny*	Newlyn
August 22	S.V.	*Louise Ernest*	Falmouth
August 22	S.S.	*Teign*	Penzance
August 22	S.V.	*Flying Foam*	London
August 22	S.V.	*Shortest Day*	Plymouth
August 22	S.V.	*Clara May*	Plymouth
August 24	S.V.	*Gertrude May*	Plymouth
August 25	S.V.	*Kate*	Helford
August 26	S.S.	*Fernside*	St. Ives
August 26	S.V.	*Alzina*	Plymouth
August 26	S.V.	*Emily Warbrick*	Falmouth
August 29	S.S.	*Magrix*	Exmouth
August 30	S.V.	*Mary Ann Mandell*	Truro
August 31	S.S.	*Treleigh*	Portreath

Sailings

Date.		Vessel.	Destination.
August 1	S.S.	*Tanny*	Penarth
August 5	S.S.	*Queenie*	Fleetwood
August 6	S.S.	*Treleigh*	Preston
August 6	M.V.	*Regina*	Pentewan
August 7	S.S.	*Magrix*	Gravesend
August 10	S.V.	*Lord Devon*	Newcastle
August 11	S.V.	*Two Sisters*	Antwerp
August 13	S.V.	*Naiad*	Charlestown
August 16	M.V.	*Maggie Annie*	Poole
August 17	S.V.	*Volant*	Runcorn
August 17	S.V.	*Hero*	Runcorn
August 17	S.S.	*Robrix*	Hull
August 19	S.V.	*Hauker*	Frederickshaw
August 19	S.V.	*C. F. H.*	Pentewan
August 19	S.S.	*Tanny*	Newlyn
August 20	S.V.	*Henrietta*	London
August 22	S.V.	*Hector Cundy*	Rochester
August 22	S.S.	*Drumlough*	Manchester
August 22	S.V.	*Winifred*	Pentewan
August 22	S.V.	*Alzina*	Plymouth
August 22	S.S.	*Tanny*	Newlyn
August 24	S.V.	*Pedestrian*	Rochester
August 24	M.V.	*Katie*	Rochester
August 24	S.S.	*Teign*	Penarth
August 25	S.V.	*Shortest Day*	Pentewan
August 26	S.V.	*Alzina*	Pentewan
August 27	S.V.	*Flying Foam*	Pentewan
August 28	S.V.	*Gertrude May*	Rochester
August 29	S.V.	*Clara May*	Plymouth
August 29	S.S.	*Fernside*	Gravelines
August 31	S.V.	*Louise Ernest*	London

Penzance Shipping

Arrival Date.	Name.	Sailing Date.	Destination.
Aug. 14,	S.S. *Hillfern*, from Cardiff	Aug. 20,	Philadelphia
Aug. 24,	S.S. *Burford Bridge*, from Blyth	Aug. 29,	Ridham

China Clay Imports for August

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of August, 1925, shows only one consignment—to the United States of America—1 ton, valued at £11.

Par Harbour Tide Table, September, 1925

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	19	7.5	7.22	12.9
Sunday	20	7.38	7.53	13.1
Monday	21	8.9	8.24	13.0
Tuesday	22	8.41	8.59	12.9
Wednesday	23	9.15	9.33	12.3
Thursday	24	9.52	10.15	11.6
Friday	25	10.41	11.9	10.9
Saturday	26	11.43	—	10.1
Sunday	27	0.22	1.8	10.2
Monday	28	1.55	2.40	11.0
Tuesday	29	3.22	3.59	12.3
Wednesday	30	4.30	4.58	13.5

October

(Greenwich Mean Time Throughout.)

(NOTE.—Summer time continues to October 4, but ALL FIGURES below are Greenwich Mean Time.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Thursday	1	4.24	4.49	14.10
Friday	2	5.11	5.32	14.3
Saturday	3	5.53	6.14	13.10
Sunday	4	6.33	6.50	13.11
Monday	5	7.8	7.26	13.6
Tuesday	6	7.44	8.0	12.9
Wednesday	7	8.15	8.32	11.10
Thursday	8	8.51	9.12	10.10
Friday	9	9.33	9.59	9.11
Saturday	10	10.29	11.3	9.4
Sunday	11	11.46	—	9.2
Monday	12	0.30	1.14	9.9
Tuesday	13	1.53	2.27	10.8
Wednesday	14	2.57	3.24	11.5
Thursday	15	3.46	4.6	12.2
Friday	16	4.25	4.45	12.8
Saturday	17	5.2	5.20	13.0

E. CLEMENS, Harbour Master.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

AYLESFORD POTTERY CO., LTD. Registered August 11, £500 mortgage to G. C. Mercer, Maidstone, banker, and another; charged on properties at Pratling Street, Boxley. *£5,400. July 22, 1924.

BASTED PAPER MILLS CO., LTD., London, E.C. Registered August 26, £35,000 debenture stock divided into £25,000 A stock and £10,000 B stock (secured by trust deed dated August 26, 1925); charged on property at Wrotham, also general charge (subject to trust deed dated May 14, 1907). *£42,000. September 1, 1924.

DUDSON WILCOX AND TILL, LTD., Hanley, pottery manufacturers. Registered August 28, £5,500 and future advances not ex. in all £6,000 mortgage to bank; charged on properties at Hanley. *Nil. May 12, 1925.

MARSHALL (J. W.) AND CO., LTD., Bolton, paper manufacturers. Registered August 27, £3,000 second debenture and £2,000 second debenture, to A. Marshall, Ridgmount, Horwich, paper maker, and R. Dobson and another, 38, Mosley Street, Manchester; general charge. *£6,000. March 13, 1925.

PORTISHEAD BRICK AND TILE WORKS, LTD. Registered August 6, £2,500 debenture to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge.

TORQUAY POTTERY CO., LTD. Registered August 6, £1,000 (not ex.) mortgage, to bank; charged on potteries and land at Hele Cross and pottery and land at Bovey Tracey. £1,500. April 4, 1925.

Satisfactions

AYLESFORD POTTERY CO., LTD. Satisfactions registered September 2. £1,500, registered June 26, 1913; and £1,500, registered July 18, 1913.

CHARLTON AND THOMPSON, LTD., Burslem, earthenware, etc. manufacturers. Satisfaction registered July 30, all moneys, etc. registered June 18, 1920.

GRIMWADES, LTD., Stoke-on-Trent, earthenware manufacturers. Satisfaction registered July 29, all moneys, etc. registered July 26, 1921.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

No Move towards a Combine

THE fact that so many China Clay firms have entered into contracts to supply China Clay at current prices for next year seems to have lessened the prospects of forming another Producers' Association this year. When the position became acute in July and August, and things were becoming desperate with some firms, it was hoped that if immediate steps were taken to get the producers together again in one organisation, the situation might be saved. Those in an exceptionally strong position, especially producers in possession of best China Clay beds, threw their weight on the side of the old Association until they felt compelled to fight their competitors in the open. The position has not materially improved, and the firms whose finances were somewhat slender even in pre-Association days, have in certain cases come to the end of their resources, and have had either to suspend operations or to put their works on the market. The break-up of the Association has been to them and to others a distressing episode in their history, as well as in the history of the China Clay industry. At present prices consumers of China Clay recognise that they are obtaining a valuable raw material at ridiculously low prices, one effect of which is that the number of users of China Clay is increasing, as well as the volume of output, but the increase in the total turnover has not been so great as was anticipated would be the case when the industry was thrown open to free competition. How long the present suicidal competition will continue depends on how soon the producers can sink their differences and come together as a united organisation. It was hoped that early this month a meeting would have been held to consider the position, but so far no such meeting has been called.

One effect of the unregulated prices of common and medium China Clays has been the impetus given to the shipping of China Clay from Charlestown and Par ports in preference to Fowey. Under the old Association all China Clay prices were quoted f.o.b. Fowey, and the advantage of shipping from Charlestown and Par did not affect business to the extent that it is now doing. These two local ports are more accessible, cheaper for transport because of their nearness to the clay works, and do away with the long rail journey to Fowey. Before this year steamers rarely visited Charlestown for China Clay cargoes, but now, both at Par and Charlestown, shipments are by no means confined to schooners. In the case of Charlestown 500-ton steamers have called in the last two or three months, which is a record for Charlestown in point of size.

During the past month there have been shipped from Charlestown and Par over 10,000 tons, a record for a single month. Neither of these ports can, of course, hope to compete with Fowey for cargoes going long distances, such as to America and Italy and Spain, but they are doing considerable coasting and cross-channel trade to French, German, Belgian, and Scandinavian ports. As shipments of clay from Charlestown and Par involve a good deal of road carriage, this results in increased business by clay carriers and motor haulage contractors.

Increasing Use for China Clay Sand

The problem of finding a use for the refuse sand, which has been one of the waste by-products in the production of China Clay, has in the last year or two been partially solved by the increasing use of China Clay sand in the building trade. For many years China Clay sand has been used as an ingredient in the mixing of mortar for building purposes, but it is only since the war that its value for the making of concrete blocks has been generally recognised. Before the war, no builder in Cornwall would think of building a house or other erection with any other material than stone, which is generally quarried in the district, and in many localities can be had for a nominal sum. The chief reasons why stone has been discarded in favour of concrete blocks made with cement and China Clay sand, are that blocks can be made to any shape required and are easily handled. Now there are dotted all over the district, and especially in the vicinity of St. Austell, firms making concrete blocks from China Clay sand, for supply to builders who are not disposed, or are not able, to make their own blocks. In the past month a limited company has been registered, with Mr. E. J. Hancock, of the West Carclaze China Clay Co., Ltd., as chairman, for the manufacture of these blocks on a large scale for supply to the building trade. The advantages of China Clay sand for concrete blocks are that the coarse quartz makes an excellent binding material in co-operation with cement, and, when used in buildings, possess a rough surface to which plaster clings easily without any special preparation. There are millions of tons of this quartz sand lying idle in the vicinity of the China Clay works of Cornwall, and in many cases the quartz can be had for the asking. In fact, the production of these blocks is rapidly developing into an important industry in the China Clay districts.

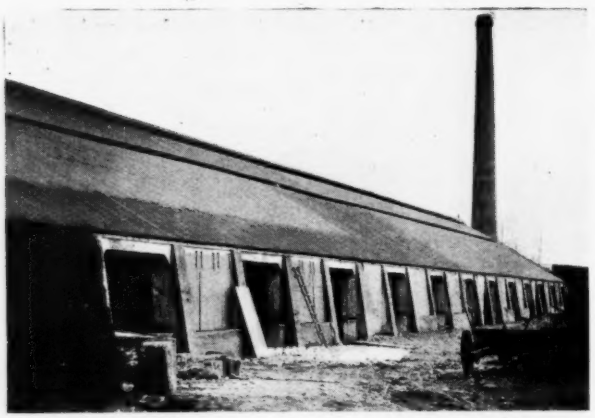
The Importance of Research

It is significant that the question of the standardisation of China Clay should form the subject of an expert article in this issue while the description of the West Carclaze China Clay Works particularly mentions the care taken by the company to meet the specific technical demands of each buyer. The fact that a resident chemist is employed in these problems suggests that the haphazard production of China Clay of varying purity, texture, and colour is now inadequate. The assistance of research as an ally to industry cannot be overestimated and the British China Clay producers cannot afford to be old fashioned. From time to time there have been reported discoveries of China Clay deposits in different countries, and although it would appear that American users at present must have English China Clay for paper and pottery manufacture, it is not safe to rely always upon this patronage. America is not slow to engage research in industry, and the balance of quality may not for ever be on our side. If potters, paper makers and other large users are all demanding China Clay conforming to certain standard specifications, and each user also desires particular characteristics, then the firm which can most nearly meet all these needs will get business. No firm marketing such products as China Clay to-day can afford to complain of trade while they ignore the assistance of research.

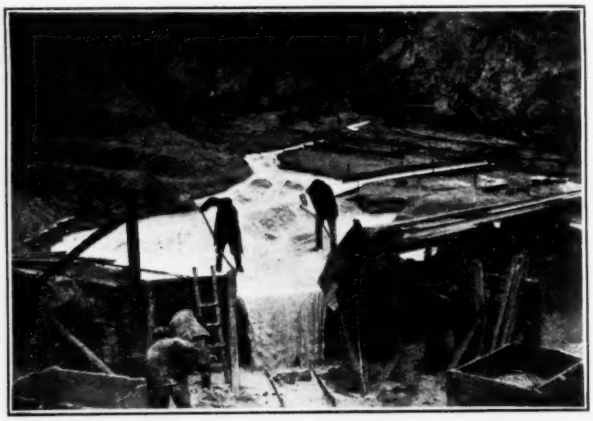
China Clay Works Visited

III.—The West Carclaze China Clay Co., Ltd.

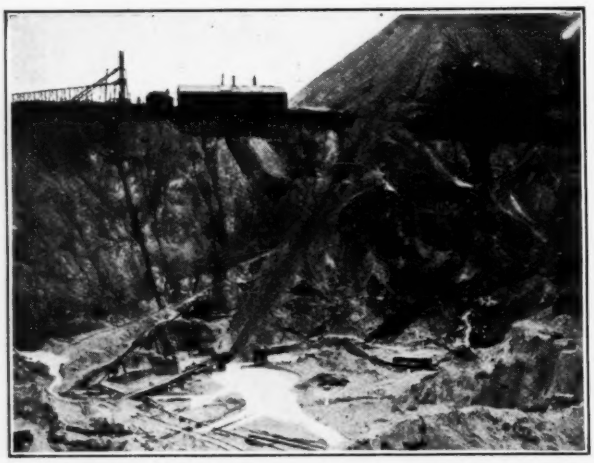
THE mines and works of the West Carclaze China Clay Co., Ltd., were started by Mr. Edward J. Hancock, the managing director, in 1913, and are amongst the China Clay enterprises that reached their full productive capacity during the war. The sett of the company occupies an extensive area, the main pit having now reached a depth of 130 ft. The company also has financial interest in and control of other pits from which clay is supplied to various home and foreign markets. It is a specially prepared grade much in demand by manufacturers of toilet requisites. Mr. Hancock gave the writer the name of a continental firm of world-wide reputation for the manufacture of toilet specialities, who are drawing their supplies of powdered or milled China Clay from his firm for their perfumed powder and cosmetic preparations. There is also a



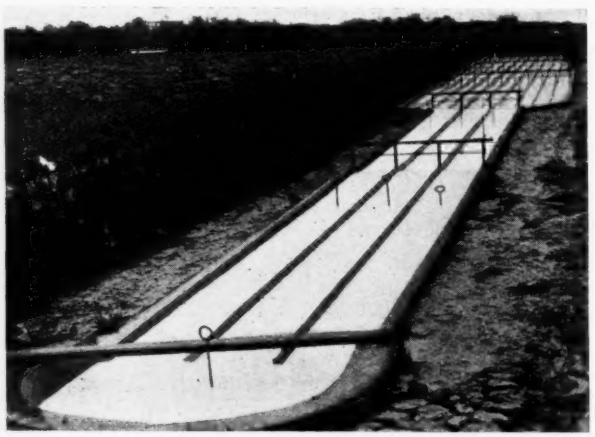
FRONT VIEW OF KILN SHOWING OPENINGS IN LINHAY THROUGH WHICH THE DRIED CLAY IS LOADED INTO LORRIES



THE CLAY STREAM AT BOTTOM OF PIT FLOWING INTO LEVEL WHENCE IT IS PUMPED TO THE SURFACE



PIT SHOWING INCLINE UP WHICH REFUSE SAND IS WOUND TO THE DUMP. ON LEFT, THE PUMP FOR DRAWING THE LIQUID CLAY TO THE REFINING MICAS AT THE SURFACE



REFINING TROUGHS, OR "MICAS" THROUGH WHICH THE CLAY FLOWS TO THE SETTLING PITS. THE COARSER PARTICLES ARE RETAINED

unlimited supplies are available. Best, medium, and common China Clays are produced for all purposes, including paper, potting, bleaching, and the chemical trades.

Modern Equipment

The works are laid out on modern lines and are electrically equipped, possessing their own power station. A Siemens generator is driven by a Ruston Proctor gas engine, and provides the current for various purposes. In keeping with the up-to-date policy of the works, a new electrically driven gravel pump has just been installed and another is on order. In order that production shall not be delayed or interfered with by any temporary breakdown in the electrical machinery, a steam stand-by plant is available for emergencies.

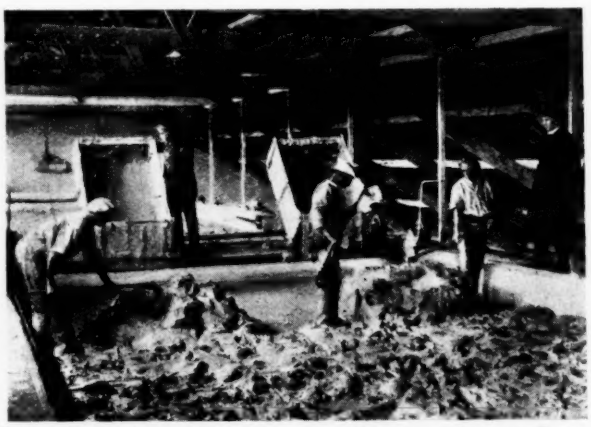
The company concentrates its attention upon the production of clays of very fine grain, free from mica, and is one of the pioneers in the industry for the production of powdered clays to meet the requirements of special industries. This powdered growing demand fo China Clay from powdered variety in the preparation of certain types of rubber.

The West Carclaze Co. has recognised the necessity of improving on the old method of producing China Clays in a haphazard manner and selling the clays so produced to all and sundry regardless of the particular requirements of different consumers. The company takes pains to ascertain the exact requirements of its customers, and then standardises its clays to meet them. The standardisation of tint, fineness, texture, etc., is a great point made by the company, and a resident chemist is employed to ensure satisfaction to consumers, to whom the chemical composition of the China Clays is a matter of primary importance.

Extensive Overseas Trade

The company, under the able and energetic guidance of its managing director, has developed an extensive overseas as well as home connection and has regular customers in

practically every China Clay consuming country in the world, whether in paper, pottery, or chemicals. Mr. Hancock showed the writer the firm's shipping order book, in which were entered the orders that have been executed during the current year. It fully bore out his statement, for in it were records of cargoes whose ultimate destinations were as far afield as Australia and the United States of America, while India, Italy, Germany, Belgium, Switzerland, France, the Netherlands, Scandinavia and Ireland were also represented. Through



WET CLAY, AFTER SETTLEMENT IN TANKS, IS SPREAD OVER PAN OF KILN TO DRY

its managing director the West Carclaze Co. also does a big business with the ball clays produced at the Newton Abbot mines in Mid Devon, and supplies some of the leading potters of the world with the material to be used in conjunction with China Clay.

Three Essentials of Sound Business

The three essentials aimed at by the company in its business with consumers are reliable quality, satisfactory service, and reasonable price. Another factor that appeals to customers, who prefer to know the all-in cost of clays delivered into their works, is the willingness of the company to quote prices for delivery into the customers' works in any town or port at home or abroad. To those who are not in the habit of buying free

MR. EDWARD J. HANCOCK, MANAGING DIRECTOR OF WEST CARCLAZE CHINA CLAY CO., LTD.

on board this is a great advantage, and saves consumers the difficulty of ascertaining the various charges that make the difference between the f.o.b. and delivery price.

The company's sales organisation is centred in Masonic Buildings, St. Austell, where its business is promptly dispatched by a competent staff, which includes two foreign correspondents, a qualified industrial chemist, and a chief accountant. A resident engineer is employed in connection with the company's works.

A Pottery Industry in Cornwall

BY CHINA CLAY "CAPTAIN."

FROM time to time the question of having a pottery in Cornwall, or at least as far west as Plymouth, is raised and discussed. The idea would be to supply the western counties with pottery without the carriage of same from the Midlands, and also to save the railway charges and shipping freights on China Clay and stone from mine and quarry to the Potteries. A great saving per ton on these staple ingredients in the manufacture of high-grade China goods would thus be effected. The increasing use of oil fuel is sometimes quoted to counteract tha main argument that it would not pay to bring coal so far west to fire the kilns.

Perhaps when the coal which is said to have been found in Devon begins to be produced in sufficient quantities that argument will be completely answered, but until that time it is possible to advance still another reason why it should be commercially possible to make such a proposition a financial success.

If a pottery in Cornwall, why not one right in the Clay district—say at Naupean, St. Dennis or Bugle? Then not only would the carriage of clay be saved, but also the drying and loading costs. *It could be delivered wet* and allowed to settle in tanks to the proper consistency for mixing. If the pottery were built near the railway at any one of the villages mentioned (which are well served by the G.W.R.) the clay from the mines on the surrounding "Cornish Heights" would run through pipes right to the settling tanks, or if time or tank room were limited for free atmospheric settling, it could gravitate through a filter press and come out in a cake ready for use.

When one thinks of the saving per ton in coal, drymen's pay, upkeep of drying kilns, and loaders' pay on top of the saving of carriage to Potteries already quoted, China Clay could probably be delivered for half what the potter has to pay for it in Staffordshire. But China Clay is not the only ingredient. China Stone could be delivered in lump or ground, by wagon or lorry, less than a five-mile journey by road; or ball clay, which is shipped in large quantities from Fowey, about ten miles from the villages mentioned; it should not cost anything like so much to bring it from Devon or Dorset as it does to ship it north via Fowey. Bone should be cheaper in Cornwall, where the demand is not so great.

"But," someone will say, "granted all that; but where are the potters—the workmen with the technical knowledge necessary to make it a commercial success?" Just so; but will not the national house shortage solve that difficulty? If a terrace of nice cottages (similar to those built by E.C. Co., Ltd., some years ago) were erected and made ready for occupation and an advertisement inserted in this and other journals circulating in the potteries, accompanied by an account of conditions, work being guaranteed, isn't it conceivable that there would soon be enough applicants to start any moderate sized pottery?

Refining Kaolin

IN the refining of kaolin, when treated by the following process, kaolins can provide a satisfactory substitute for English China Clay and for some ball clays used in potteries.

A moderately dry clay is crushed through corrugated rolls, submitted to a thorough blunging in ball mills with water and caustic soda. The latter is adjusted to suit the clay and added at the rate of 10 c.c. per sec.; the clay and water being fed at a uniform rate. As insufficient blunging is disastrous, two and sometimes three blungings are advisable, according to *The British Clayworker*.

To flocculate the clay, just sufficient sulphuric acid to neutralise the soda is mixed with the liquid as it flows through the troughs. It is next run through a rifled trough with a slope 1 : 50, to accelerate the flow, through a rotary screen 120 mesh, and finally into concrete settling tanks, where, in less than 24 hours, the clay settles. A steady viscosity must be maintained in the slip at the head of the trough, and before entering the final trough it must be well agitated. As a large volume of air is absorbed by clay slips, they must be thoroughly stirred before determining their viscosity.

After the supernatant liquor has been run off, the thick slip is filter-pressed and the resultant cakes dried by steam.

Standardising China Clay

The Importance of Fine Grain

THERE is a growing demand by users of China Clay, chiefly by manufacturers of pottery and paper, for a material which conforms to certain standard specifications, and the producer is pressed more and more for a well-defined standard clay. Special industries where ordinary China Clay and powdered China Clay are used in comparatively small quantities have long insisted on a material which satisfies certain definite tests, but to the China Clay industry as a whole these have been relatively unimportant.

In a previous article the chemical purification of China Clay was discussed in so far as it effected the colour of the clay in the raw state. Colour, *i.e.* whiteness in the raw state of a clay, is important from the point of view of the manufacturer of high-grade paper, but to the potter it is of no consequence. What is of importance to potter and paper maker alike is the fineness of a clay. The paper maker must have a clay which is white and fine grained, the potter wants a fine-grained clay. Fineness depends almost entirely on the washing of a clay.

China Clay is found, as a rule, in conjunction with, and mixed with granite, silica, etc., in various stages of disintegration. When the washing water is turned on to the "stope" or face of the clay bed, portions of rock, stones, sand, and other gritty constituents of the lodes which generally run criss-cross through a clay bed, fall away. The impurities lumped together under "other gritty constituents" cause most trouble owing to their small size. The stone gets no further than the foot of the face whence it is trammed away. Similarly the sand is caught in sand pits and withdrawn. The smaller and lighter impurities are pumped to the surface in suspension in the clay stream. On reaching the surface the stream is diluted with clear water, if this is available, and the addition practical, and flows on a long course of purification to the settling pits. It is led first into the round-head, a basin-shaped depression or pit where its speed is suddenly reduced owing to the larger area over which it can flow. The coarse grit and larger crystalline particles settle here, and by pulling out a plug from the bottom of the round-head the sediment can be washed away. The stream then flows slowly through the "micas," long terraced channels distributed over a wide area. This is the important point in the purifying process and one which determines the quality of the clay.

Dilution and Distribution

The stream must not contain more than 2½ per cent. solid matter in suspension. The importance of dilution is apparent when it is considered that the specific gravity of the heaviest crystalline mica is approximately 3·0 as against 2·5 (approxmate) for China Clay, and the particles are very minute. If the stream travels slowly the "mica" (which in the trade covers mica, grit and everything objectionable in a clay), will settle.

The even distribution of the stream between the channels, of which there are usually eight for a mine producing about 100 tons of China Clay per week, is also important. If the stream is allowed to confine itself to three or four channels its speed through these is increased, the surface area on which the mica can settle is decreased, and it literally rushes over the traps from length to length of the "micas," carrying the micas along with it to the settling pits. The only exception is when the stream has to pass over and through screens as a final stage in the process, but fine screens are not yet in general use.

No less necessary is the regular adjustment of the traps used to prevent mica being carried along as the drags fill. Automatic traps are employed by many companies, but, generally speaking, the human element cannot be dispensed with here and personal and intelligent attention at this point undoubtedly pays.

Detecting Mica in Clay

Mica betrays its presence in a clay in many different ways. A lump of clay containing mica scintillates when viewed in the light from different angles. When the clay is made into a paste with water the colour is toned down and the wet clay loses this property and also its plasticity. In no case does the presence of mica improve the clay for pottery or for paper. The paper maker regards it as a nuisance because it compels him to clean his lawns more frequently than is necessary. An expert buyer of paper has no difficulty in detecting mica in a paper. If mica is mixed with an ordinary sample of a good pottery clay which when heated to 1,200° C. becomes white, the fired mixture will show pink spots due to mica. A layer or streak of mica in a clay is sufficient to cause the clay to break along this line after it has been fired.

China Clay is used in the manufacture of certain classes of pottery merely on account of its binding action. It is mixed with the other materials to make the potter's slip and binds the different constituents together when heated. Mica has not this binding action to such a degree as China Clay. All micas do not necessarily become pink after being fired. Some come out of the oven a good white colour, but this mica is found, as a rule, in conjunction with a good potting clay.

The Cornish and Devon China Clay producers have long had a monopoly, but they no longer occupy this privileged position. China Clay has to compete keenly with other materials, both in this country and abroad, and producers if they would maintain that position must rise to the occasion and satisfy the reasonable demands of consumers. E. J. L.

New Uses for China Clay

Recent Patents and Processes

Manufacture of Silica Bricks. John Wilson, U.S.A.
The herein described method of manufacturing highly refractory brick, which consists in intimately mixing China Clay and lime each in a finely divided condition with natural siliceous stone, also in a finely divided condition, the percentage of China Clay being of the order of about 2·5 per cent. and that of the lime about 1·5 per cent., and forming the mixture into brick. (1,534,199.)

Ceramic and Refractory Materials. C. E. Kraus. British.
The plasticity of ceramic materials, refractory compositions, mortars, etc., containing clay, kaolin, bauxite, flint, asbestos, $CaCo_3$ or similar ingredients, is increased by the addition of 5–20 per cent. of a highly colloidal earth such as bentonite, ehrenbergite, damonterolite or montmorilonite, with or without cork or other combustible substances which are burnt out to produce porous heat-insulation. (224,257.)

Ball Clay. Hans Hirsch. German.
Examples of rich clays which allow a diminishing of the plasticity to a great extent. Discussion of properties which allow one to determine numerically the practical value of the clays. Moistening, extension, tensile strength, softening under pressure, colloidal structure. (1,155–7.)

Glaze upon Porcelain. E. Gerold. German.
It was found that different glazes had a marked effect upon the following properties of high tension porcelain insulators: (1) modulus of elasticity; (2) tensile strength; (3) modulus of rupture; and (4) resistance to impact. The same glazes tested on different bodies influenced the properties of these bodies in the same way. The glazes did not only change the properties of thin bodies but also had a marked influence upon the thicker bodies. The influence of three glazes upon the properties of a porcelain was studied. It was found that all three glazes increased the elasticity coefficient. Two glazes decreased and one increased the tensile strength. Two glazes decreased and a third increased the modulus of rupture. Two glazes decreased the resistance of the porcelain to impact, while a third did not influence the body very much in this respect. Experiments were conducted to determine the influence of grinding these glazes off upon the properties of the porcelain. It was found that the modulus of rupture and the resistance of the body to impact became practically the same as the unglazed body after the glazes had been ground off. The elasticity coefficient was somewhat higher on the body from which the glaze had been ground off than that of the unglazed body. Experiments were also conducted to determine the influence of slowly grinding off the glaze of the porcelain and then grinding off the outer skin of the body upon the tensile strength of the body. It was found that as the glaze was slowly ground off the tensile strength approached that of the unglazed body. As the outer skin of the body was ground off the strength of the porcelain decreased quite markedly, showing that the outer skin imparts strength to the porcelain. The influence of these glazes upon the properties of insulators 72 mm. thick was almost as great as upon bodies 20 mm. thick. (188–90.)

Chemical Purification of China Clay

Producers too Conservative

In the course of a letter published in The Chemical Age of September 26, Mr. A. Worsley, of Isleworth, said that—"There is no difficulty whatever in removing iron stains from clays, but there are economic limitations to chemical purification. Selective mining of some particular grade is not always feasible, and generally adds to the cost of operation. In some cases operators on the best setts find a difficulty in marketing their white clays of the highest grade at a speed which keeps pace with the sales of lower grades. Such operators will not look at any proposal to spend money on purifying the grades which they can sell unpurified. Although it does not cost more than a few shillings per ton treated to remove iron stains from good-grade China Clays, yet this few shillings represents the difference in value between the best grade and the grade just below it. Hence, it would not be economic to turn grade B into grade A by treatment. Now, if one treats lower grades such as C, D, etc.—clays still more heavily stained—the cost of treatment will rise with the amount of iron to be removed. There is the fact that the market for the highest grade of pure white, 'semi-colloidal' clay is limited, and would be quickly overstocked if everyone purified their high-grade clays. But, for the reasons just given, this will not take place.

"For two years some smaller operators have purified clays chemically and obtained pure white clays from stained clays in England, but the big operators seem very conservative, and the Cornish firms show no interest in what is being done elsewhere. I have had clays sent to me from overseas, some of which were actually yellow, but which were returned to the senders pure white and free from iron. In America, chemical purification of clays is making rapid headway, and if, in coming years, we retain our export trade it will not be on account of the superior whiteness of our clays, but solely on account of their physical properties, in which respect Cornish China Clays are probably supreme. The same process is applicable to barytes. In this mineral we once held a monopoly. Now we import largely from countries which have kept abreast with modern knowledge."

September Deliveries of China Clay

Following the drop in the August deliveries on account of the holidays, a substantial recovery was made in the deliveries of China Clay in September, the total in all classes delivered representing the third largest monthly turnover for the year, with a total of 83,424 tons. This total has only been exceeded in May (86,671 tons) and in March (98,598 tons). The deliveries of China Clay for September were increased by over 15,000 tons, but there was only a few tons increase in the deliveries of China stone, and a decrease of 700 tons in the deliveries of ball clay. From Fowey alone the increase in China Clay shipments was 12,000 tons compared with August, while Par increased its quantities by 1,600 tons. The total of 6,175 tons (including 687 tons China stone) from Par during the month represents a record for this port. The details of deliveries for September, together with the totals for the previous eight months are given below. Comparisons with the corresponding nine months last year show the aggregate total to be 43,165 tons in favour of this year.

Port.	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
	1925.	1924.	1925.	1924.	1925.	1924.	1925.	1924.
Fowey	60,316	56,218	3,494	4,358	2,015	3,009	65,825	63,585
Par	5,488	5,418	687	—	—	—	6,175	5,418
Charlestown....	5,821	4,778	—	—	—	—	5,821	4,778
Plymouth.....	920	1,708	—	10	—	333	920	2,051
Looe	154	—	—	—	—	—	154	—
Newham.....	—	418	—	—	—	—	—	418
By rail	4,529	4,767	—	—	—	—	4,529	4,767
Total	77,228	73,307	4,181	4,368	2,015	3,342	83,424	81,017
August	66,184	61,681	4,132	6,009	2,720	1,970	73,036	69,660
July	67,032	68,951	6,561	5,347	2,787	8,005	77,390	82,303
June	69,022	58,504	3,830	3,310	2,619	3,076	75,471	64,890
May	80,860	82,405	4,286	3,363	1,825	2,859	86,671	88,357
April	59,624	75,311	3,198	4,651	1,118	2,627	63,940	82,589
March	94,217	74,191	2,526	4,132	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,056	3,978	3,050	1,567	80,046	62,231
Total 9 months	655,520	603,280	34,656	36,753	18,603	26,591	709,789	666,624

United States Clay Production

Kaolin Output Down

The output of clay mined and sold as clay in the United States in 1924 amounted to 3,676,720 short tons, valued at $11,478,756, or $3.12 a ton, according to the Bureau of Mines, Department of Commerce. These figures show an increase of about 7 per cent. in quantity and 3 per cent. in value, as compared with those of 1923. They represent only clay sold as clay, or mined under royalty, and do not include the much greater quantity of clay that was burned into clay products by the producers themselves from their own property.

The output of kaolin, which is used in making high-grade pottery and porcelain, as well as paper, oilcloth, and other products and is generally considered the highest grade of clay, amounted to 326,602 tons, valued at $2,923,965, a decrease of 3 per cent. in quantity, as compared with 1923, with practically the same value as for 1923. The clay of largest production and value was fireclay. The output of fireclay was the largest ever recorded—2,429,320 tons—and was 6 per cent. greater than that of 1923 and 3 per cent. greater than that of 1917, the year of largest output previous to 1924. The value of the fireclay output of 1924 was $6,708,283, an increase of 2 per cent. as compared with 1923, but a decrease of 5 per cent. as compared with 1920, the year of greatest value of fireclay. The output of clay of every kind decreased in quantity and value in 1924, except fireclay and miscellaneous clay, which consists largely of clays used for heavy clay products such as building and drainage materials. The imports of clay amounted to 444,100 short tons, valued at $3,976,040, an increase of 13 per cent. in quantity and 8 per cent. in value. Exports of clay in 1924 amounted to 72,755 tons, valued at $732,716. This was a decrease of 14 per cent. in quantity and an increase of 16 per cent. in value, as compared with 1923. Kaolin, or China Clay, constituted 80 per cent of the total imports in 1924. Fireclay, the principal clay exported, amounted to 57 per cent. of the total.

China Clay Sand Concrete Companies

New companies registered include—Central Cornwall Concrete and Artificial Stone Co., Ltd. (208240). September 4, 1925. To carry on the business indicated by the title. Nominal capital £7,500, in 7,250 ordinary shares of £1 each and 5,000 founders' shares of 1s. each. Permanent directors: D. Warne, "Penarth," Bugle, Cornwall (managing director); R. H. Tonkin, Bugle (sales manager); P. G. Tonkin, Bugle (secretary); E. J. Hancock, "Bay House," St. Austell (chairman). Qualification of permanent directors: 100 shares.

The Goss Moor Concrete Co., which has been carrying on concrete block making for the past twelve months, has been registered as a private limited company with a share capital of £5,000. The registered offices are at Glencoe, Roche. Directors: Evelyn M. Jackson and H. F. Jackson, Glencoe, Roche; A. G. Stevens, 6, Leyborne Avenue, Ealing.

China Clay Merchant's Loss

While on holiday in Wales, Mr. T. C. Ellis, a St. Austell China Clay merchant, had his house burgled, but most of the property, principally jewellery, was recovered. The total value was about £40. At St. Austell Police Court, James Guy was charged with the offence, and Nellie Roberts was charged with aiding and abetting. At Bodmin Quarter Sessions, on October 6th, the male prisoner was sentenced to two years' hard labour and the woman to twelve months' imprisonment. There were thirteen previous convictions against the male prisoner for stealing and housebreaking, the last at Bristol in 1919.

A £1,000 Gift

Mr. J. Rogers, of Bolowthas, Newquay, has given £1,000 to the Royal Cornwall Infirmary to endow a bed in memory of his son, Captain J. L. Rogers, of the 1/4th D.C.L.I., who lost his life in the war.

China Clay Notes and News

St. Austell Cottage Hospital Finance

As so many China Clay firms support the St. Austell Cottage Hospital as members of the Committee and as subscribers, they will be interested in its finances. The services of Messrs. H. Stocker and G. H. Grenfell (both connected with English China Clays, Ltd.), as hon. treasurer and hon. secretary, are much valued, and now the services of Mr. J. W. Higman, another prominent China Clay merchant, have been requisitioned as chairman of the Committee in the place of Mr. E. B. Vian, interested in the cooperage department of English China Clays, Ltd., who has just retired. At the annual meeting of the hospital Mr. H. Stocker, in presenting the financial statement, said that they had received 350 patients for the year, compared with 290 for the previous year. The annual subscriptions amounted to £442, compared with £455 for the year previous, and donations came to £116, against £367, which was a distinct drop. The contributions were £321, against £266 for the previous year. It was very gratifying to find that increase, taking into consideration the fact that the China Clay area was at present working under unsettled conditions. The amount of acknowledgments received from patients was £176, compared with £243 for the year previous, which was not altogether gratifying or satisfactory. In spite of increased expenditure there was a slightly larger balance in hand. The year opened with £482, and finished up with £578. The authorities wished to impress upon the public the need for greater care and energy to meet their greatly increasing expenditure.

With regard to the extension fund, the donations amounted to £3,339, which was in addition to the annual maintenance donations.

The hospital was reopened on October 3 by Sir Francis Layland Barratt, the president, who has been a generous supporter of the hospital. Mr. J. W. Higman presided, and remarked that the institution was now the best equipped in the county. The accommodation has been doubled—from 12 to 24 beds; the latest sanitary plant and apparatus have been introduced into the ward equipment and the operating theatre; a room has been added to accommodate Sir Francis Layland Barratt's gift of X-ray apparatus; a sterilising room has been provided apart from the theatre, boilers have been installed to heat the radiators in the wards and to provide hot water; the ward kitchen has been enlarged, and it has been possible to provide a sitting-room for the staff, as well as two private wards. Electric light has also been introduced.

Good News for Clay Firms

At the last meeting of the St. Austell Rural Council, which controls the area in which most of the China Clay works are situated, Mr. E. J. G. Mitchell, in submitting the Finance Committee's report, remarked that they were very pleased to be in a position to recommend the same rate as last time. This was particularly satisfactory in view of the fact that several other districts had had to increase their rate. The Committee recommended a rate of 2s. 7d. in the £, and included a penny rate to meet the Council's contribution towards the by-pass road around St. Austell. The Committee also recommended the calling up of the following amounts to meet special expenses of particular parishes:—St. Austell Rural, £2,450; Roche, £684; Tywardreath, £840; St. Blazey, £805; St. Stephens, £1,500; St. Dennis, £819.

Clay Producer's Tribute to Workers

Mr. W. T. Lovering, submitting the toast of "St. Austell's Detachment of the 4th and 5th Battalion, D.C.L.I." at the annual dinner last month, expressed the hope that next year they would have double the attendance at the function. The detachment used to be one of the strongest companies in the county, and he urged them to persuade their friends and fellow workmen to join the St. Austell Company. A good workman made a good territorial, and he knew many of them as good workmen. There were no better workmen to be found in the British Isles than in the China Clay district of St. Austell.

St. Austell Building Schemes

At the last meeting of the St. Austell Urban Council, Councillor Mitchell, in submitting the General Purposes Committee's report recommending the approval of plans for the erection of ten more houses and bungalows, said nothing succeeded like success. It was very gratifying to find that since they had been in power in that area, building had been progressing very satisfactorily. Comparing the last six months with the four or five years previously, the progress was very gratifying to the Council and to the community in general. Already in their six months of office, plans had been passed for 21 buildings. By comparison with other places, theirs was the most progressive area in the whole of the county. Councillor Luke (who is a director of West Carclaze China Clay Co., Ltd.) said that if the building continued at the present pace all the vacant land would be occupied and they would have soon to ask for an extension of the present area. The Council decided to embark on a £3,000 scheme for hard tennis courts and bowling greens.

Famous China Clay Dispute Recalled

The death at Newquay of Mr. C. E. Davis, aged 71, of St. Stephens, after several years' illness, recalls a famous dispute between the G.W.R. Co. and the Carpella China Clay Co. several years ago, when the courts were called upon to decide whether China Clay was a mineral. The question had to be decided in consequence of the G.W.R. wanting to encroach on land on the Clay Co.'s property, they being liable to pay compensation for minerals. The G.W.R. contested the claim of the company that China Clay was a mineral, but although the case went to the Court of Appeal, it was held that China Clay was a mineral. Mr. Davis was responsible for the development of Carpella China Clay works, and it was when he was managing director that the dispute took place. A year or two before the war Spicer Brothers, paper makers, acquired a controlling interest in the company, but Mr. Davis retained the position of manager until his breakdown in health.

A Public Figure

Mr. Davis was another instance in the China Clay district of the triumph of ability over the disadvantage of unaided youth. From the age of 12 he worked at the shoemaker's bench, but he also studied, and as a young man entered the Nonconformist ministry, but that sphere of labour was short-lived. His public work carried him eventually to the County Aldermanic bench. He had served in every branch of public work—Parish Council, Rural Council and Guardians, Education Committees, the Magisterial bench, the County Council, politics. In the St. Stephen's parish, where he was born, he was looked upon for years, up to the time when he had to leave to seek the more congenial climate of Falmouth, as a kind of public adviser. He was a natural speaker of marked ability.

Improving China Clay District Roads

The St. Austell Rural Council have submitted to the Ministry of Transport an application for a grant of 50 per cent. of the cost of resurfacing the following roads: Bugle-Roche, Tywardreath Village to Castledore, Tregrehan Mills from Four Turnings to Main Road, Stepaside to Little Treviscoe, Pengruglar-Peruppa-Tregiskey, Restowrack Downs. The Council are of opinion that in the interests of economy the practice of treating these roads with a water-bound surface be discontinued, and if the Ministry of Transport will make a grant of 50 per cent. it will be more economical to pay the loan and interest charges on the remaining 50 per cent. than the annual cost of water-bound surfaces. It is estimated that the annual loan and interest charges will approximate a 1½d. rate.

Week's Traffic Census to Charlestown

At the last meeting of St. Austell Urban Council the surveyor reported that a week's census showed the traffic passing over the road to Charlestown was 10,242 tons. Application was made to the Ministry of Transport for the classification of this road, the Rural Council having already made application for the classification of the road from Carclaze to Bugle.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—September, 1925

Arrived.	Name.	Sailed.	Destination.
Sept. 1,	*Pacific*	Sept. 12,	Gravelines
Sept. 1, s.s.	*Errington Dunford*	Sept. 8,	Montreal
Sept. 3, s.s.	*Hayle*	Sept. 7,	Runcorn
Sept. 3, s.s.	*Singapore Maru*	Sept. 7,	Portland, Me.
Sept. 3, s.s.	*Sussetta*	Sept. 9,	Preston
Sept. 3, s.s.	*Allen*	Sept. 10,	Oscarshamn
Sept. 4, s.s.	*Gem*	Sept. 10,	Runcorn
Sept. 4,	*Ruth*	Sept. 23,	Wiborg
Sept. 4, m.s.	*Cimbria*	Sept. 11,	Odense
Sept. 7, s.s.	*Dragoon*	Sept. 11,	Liverpool
Sept. 7, s.s.	*Clarette*	Sept. 11,	Weston Point
Sept. 7, m.v.	*Johanna Ipland*	Sept. 12,	Zarate
Sept. 7, s.s.	*Ravenspoint*	Sept. 12,	Genoa
Sept. 8, m.v.	*Bessie Ellen*	Sept. 23,	Falmouth
Sept. 9, s.s.	*Girasol*	Sept. 14,	Terneuzen
Sept. 9, s.s.	*Alice*	Sept. 14,	Preston
Sept. 10, s.s.	*Mellanear*	Sept. 15,	Runcorn
Sept. 10,	*Triumph*	Sept. 10,	Plymouth
Sept. 10, m.v.	*Lydia Cardell*		*
Sept. 10, s.s.	*Foamville*	Sept. 15,	Weston Point
Sept. 11, s.s.	*Mungret*	Sept. 16,	Antwerp
Sept. 11, s.s.	*Horsham*	Sept. 16,	Antwerp
Sept. 11, s.s.	*Ravendal*	Sept. 19,	Skien
Sept. 12,	*Richard*	Sept. 23,	Gefle
Sept. 12, s.s.	*Primrose*	Sept. 16,	Rouen
Sept. 14, s.s.	*Alison*	Sept. 17,	Gravelines
Sept. 14,	*Garibaldi*	Sept. 23,	Teignmouth
Sept. 14, s.s.	*Hayle*	Sept. 16,	Runcorn
Sept. 14, s.s.	*Sojourner*	Sept. 17,	Grimsby
Sept. 14, s.s.	*Falmouth Castle*	Sept. 16,	Runcorn
Sept. 14,	*Pedestrian*	Sept. 17,	Par
Sept. 15, s.s.	*Farfield*	Sept. 19,	Antwerp
Sept. 15, m.v.	*Noordkapp*	Sept. 19,	Helsingfors
Sept. 15, m.v.	*Crown of Denmark*	Sept. 17,	Polperro
Sept. 15, s.s.	*Halton*	Sept. 19,	Birkenhead
Sept. 16,	*Lady Daphne*	Sept. 26,	Rochester
Sept. 16, m.v.	*Corrie*	Sept. 21,	Hamburg
Sept. 16, s.s.	*Rosalie*	Sept. 16,	Charlestown
Sept. 17, s.s.	*Clara Monks*	Sept. 18,	Aberdeen
Sept. 17,	*Erhardt*	Sept. 29,	Raumo
Sept. 17, s.s.	*Gertie*	Sept. 19,	Runcorn
Sept. 18, s.s.	*Landport*	Sept. 24,	Brussels
Sept. 18, s.s.	*Barflo*	Sept. 22,	Brussels
Sept. 18, s.s.	*Bonawe*	Sept. 19,	Charlestown
Sept. 19, s.s.	*Scotland Maru*	Oct. 1,	Philadelphia
Sept. 20,	*Gull*	Sept. 23,	Stockholm
Sept. 21, s.s.	*Ciscar*	Sept. 24,	Genoa
Sept. 22, s.s.	*Primrose*	Sept. 24,	Preston
Sept. 22, s.s.	*Vechtstroom*	Sept. 24,	Amsterdam
Sept. 23, s.s.	*Herfinn*	Sept. 26,	Antwerp
Sept. 23, s.s.	*Bonawe*	Sept. 26,	Weston Point
Sept. 24, s.s.	*Glencregagh*	Sept. 26,	Irvine
Sept. 24, s.s.	*Gaurdian*	Sept. 26,	Antwerp
Sept. 24, s.s.	*Dorset Coast*	Sept. 25,	Liverpool
Sept. 24, m.v.	*Crown of Denmark*	Oct. 3,	Runcorn
Sept. 24, s.s.	*Karla*	Sept. 29,	Genoa
Sept. 25, s.s.	*Baron Minto*	Oct. 7,	Philadelphia
Sept. 25, s.s.	*Clarette*	Sept. 29,	Runcorn
Sept. 25, s.s.	*Cornish Trader*	Sept. 29,	Antwerp
Sept. 25, s.s.	*Fingal*	Oct. 1,	Sarpsborg
Sept. 25, s.s.	*Broadgreen*	Sept. 30,	Bilbao
Sept. 25, s.s.	*Magrix*	Sept. 23,	Par
Sept. 25,	*Waterwitch*	Sept. 26,	Newcastle
Sept. 25,	*Gauntlet*	Sept. 29,	Looe
Sept. 27, m.v.	*Jupiter*	Oct. 2,	Reval
Sept. 27, s.s.	*Monksville*	Oct. 1,	Weston Point
Sept. 27, s.s.	*Avanville*	Oct. 3,	Rouen
Sept. 27, m.v.	*Zeehond*	Oct. 3,	Bremen
Sept. 27, s.s.	*Rossmore*	Oct. 3,	Bo'ness
Sept. 27, s.s.	*Emily*	Oct. 5,	Kotka
Sept. 27, s.s.	*Shoreham*	Sept. 30,	Cardiff
Sept. 27, s.s.	*Kifaku Maru*		*
Sept. 27, m.v.	*Johannes*	Oct. 1,	Monkedal
Sept. 28, s.s.	*Gouwestroom*	Oct. 8,	Amsterdam
Sept. 28, s.s.	*Tanny*	Sept. 30,	Lydney
Sept. 29, m.v.	*Dronning Margrethe*	Oct. 6,	Odense
Sept. 29, s.s.	*Quebec City*		*
Sept. 29,	*Thorvald*		*
Sept. 29, m.v.	*Margot*	Oct. 7,	Gothenborg
Sept. 29, s.s.	*Siam City*		*
Sept. 29, s.s.	*Katherine*	Sept. 30,	Plymouth
Sept. 30, m.v.	*Sampo*	Oct. 10,	Copenhagen
Sept. 30,	*Ernst*		*
Sept. 30, s.s.	*Hayle*	Oct. 8,	Weston Point

*In port.

Charlestown Shipping—September, 1925

Arrivals

Date.	Vessel.	From
Sept. 4	*Paul Arsene*	Plymouth
Sept. 4	*Daisy*	Falmouth
Sept. 4	*Carrie*	Frangsund
Sept. 5	*Ludvig*	Frangsund
Sept. 6	*Samoa*	Portsmouth
Sept. 8	*Brettonne*	Plymouth
Sept. 8	*Nalan*	Topsham
Sept. 9	*Porthleven*	Plymouth
Sept. 9	*Lady Rosebery*	Southampton
Sept. 12	*Freighter*	Weymouth
Sept. 16	*Rosalie*	Weymouth
Sept. 16	*Millocrat*	Falmouth
Sept. 20	*St. Brandon*	Truro
Sept. 20	*Bonawe*	Barry
Sept. 20	*Waterwitch*	Fowey
Sept. 23	*Karrten*	Poole
Sept. 23	*Locking Naval*	St. Brieux
Sept. 23	*Seatford*	Penryn
Sept. 25	*Lady Thomas*	Guernsey
Sept. 24	*Samoa*	Liverpool
Sept. 26	*Naiad*	Porthleven
Sept. 27	*Poolgate*	Penryn

Sailings

Date	Vessel	Destination.
Sept. 5	*Vera*	Leith
Sept. 6	*Paul Arsene*	Nantes
Sept. 7	*Samoa*	Runcorn
Sept. 8	*Nalan*	Brussels
Sept. 9	*Porthleven*	London
Sept. 12	*Lady Rosebery*	Rochester
Sept. 16	*Brettonne*	Nantes
Sept. 16	*Freighter*	Sunderland
Sept. 17	*Rosalie*	Antwerp
Sept. 17	*Millocrat*	Preston
Sept. 21	*St. Brandon*	Rochester
Sept. 23	*Waterwitch*	Newcastle
Sept. 23	*Locking Naval*	Kotka
Sept. 24	*Karrten*	Hamburg
Sept. 24	*Seatford*	Barrow
Sept. 25	*Lady Thomas*	Manchester
Sept. 28	*Poolgate*	Rouen
Sept. 30	*Samoa*	Preston
Sept. 30	*Naiad*	London

Par Harbour Shipping—September, 1925

Arrivals

Date.	Vessel.	From.
September 1, s.s.	*Penhryn*	Southampton
September 2, s.s.	*Mia*	Penzance
September 2, s.s.	*Slateford*	Southampton
September 3, s.s.	*Queenie*	Newport
September 3, s.s.	*Orenie*	Weymouth
September 4, m.v.	*Amphitrite*	Teignmouth
September 4, s.v.	*Christian*	Landerneaux
September 4, s.v.	*W. E. Gladstone*	Plymouth
September 4, s.s.	*River Humber*	Cardiff
September 6, s.s.	*Oaktown*	Port-en-Bessin
September 8, m.v.	*Katie*	Rochester
September 8, s.s.	*Matje*	Pentewan
September 8, s.s.	*Lord Devon*	Blyth
September 9,	*F. H. C. No. 2*	Fowey
September 11, s.v.	*Mary Barrow*	Fowey
September 16, m.v.	*X167*	Porthoustock
September 16, s.s.	*Tanny*	Plymouth
September 16, s.v.	*Pedestrian*	London
September 18, s.s.	*Treleigh*	Cardiff
September 18, s.v.	*W. E. Gladstone*	Plymouth
September 19, s.v.	*Scone*	Plymouth
September 23, s.s.	*Magrix*	Teignmouth
September 23, s.s.	*Porthleven*	Truro

September 24, M.V.	*William John*	Plymouth
September 27, S.V.	*Fanny Crossfield*	Falmouth
September 28, M.V.	*Bessie Ellen*	Newlyn
September 28, S.S.	*Falmouth Castle*	Falmouth
September 29, S.S.	*James Tennant*	Topsham
September 30, S.S.	*Magrix*	Truro
September 30, S.S.	*Clyde Firth*	Torquay

Sailings

Date.	Vessel.	Destination.
September 2, S.S.	*Treleigh*	Preston
September 4, S.S.	*Magrix*	London
September 5, S.S.	*Penrhyn*	Fleetwood
September 5, S.S.	*Mia*	Fleetwood
September 7, S.S.	*Slateford*	Gravesend
September 7, S.S.	*Orenie*	Antwerp
September 8, S.S.	*Queenie*	Manchester
September 9, S.S.	*River Humber*	Llanelly
September 9, S.S.	*Oaktown*	Kirkcaldy
September 11, S.V.	*W. E. Gladstone*	Pentewan
September 12,	*F. H. C. No. 2*	Fowey
September 13, S.S.	*Matje*	Liverpool
September 16, S.V.	*Mary Ann Mandall*	London
September 16, M.V.	*Amphitrite*	Boulogne
September 16, S.V.	*Alert*	Runcorn
September 16, S.V.	*Snowflake*	Runcorn
September 16, S.V.	*Emily Warbrick*	Weston Point
September 18, S.V.	*Christian*	Viborg
September 18, M.V.	*X167*	Falmouth
September 18, S.S.	*Tanny*	Penarth
September 23, S.V.	*Lord Devon*	London
September 23, S.S.	*Treleigh*	Preston
September 23, S.S.	*Magrix*	Truro
September 24, S.V.	*W. E. Gladstone*	Pentewan
September 24, S.S.	*Porthleven*	Gravesend
September 25, S.V.	*Scone*	Queenboro'
September 30, S.V.	*Kate*	Rochester
September 30, M.V.	*Katie*	Rochester
September 30, M.V.	*Bessie Ellen*	Falmouth
September 30, S.S.	*Magrix*	Gravesend

Par Harbour Tide Table, October, 1925

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Sunday	18	5.36	5.53	13.2
Monday	19	6.10	6.27	13.6
Tuesday	20	6.44	7.1	13.4
Wednesday	21	7.18	7.37	13.0
Thursday	22	7.58	8.16	12.5
Friday	23	8.38	9.1	11.8
Saturday	24	9.27	9.58	11.0
Sunday	25	10.33	11.15	10.6
Monday	26	—	0.2	10.8
Tuesday	27	0.46	1.29	11.5
Wednesday	28	2.6	2.41	12.3
Thursday	29	3.13	3.39	12.11
Friday	30	4.4	4.27	13.4
Saturday	31	4.50	5.10	13.6
	November			
Sunday	1	5.31	5.50	13.7
Monday	2	6.9	6.27	13.6
Tuesday	3	6.42	6.59	13.1
Wednesday	4	7.16	7.33	12.6
Thursday	5	7.51	8.6	11.8
Friday	6	8.23	8.43	11.1
Saturday	7	9.5	9.26	10.5
Sunday	8	9.53	10.22	10.11
Monday	9	10.57	11.35	9.9
Tuesday	10	—	0.17	9.9
Wednesday	11	0.58	1.34	10.2
Thursday	12	2.8	2.36	10.11
Friday	13	3.3	3.25	11.7
Saturday	14	3.46	4.5	12.4
Sunday	15	4.25	4.46	12.11
Monday	16	5.4	5.24	13.4
Tuesday	17	5.44	6.5	13.5
Wednesday	18	6.25	6.44	13.6
Thursday	19	7.4	7.24	13.2
Friday	20	7.50	8.9	12.9
Saturday	21	8.32	8.57	12.3
Sunday	22	9.26	9.55	11.7
Monday	23	10.28	11.2	11.3
Tuesday	24	11.43	—	10.10
Wednesday	25	0.25	1.5	11.6
Thursday	26	1.41	2.15	11.7

E. CLEMENS, Harbour Master.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

POLING POTTERY, BRICK AND TILE WORKS, LTD., Brighton. Registered September 9, £7,500 debentures; general charge.

China Clay Exports for September

RETURN showing the exports of Clay: China, including Cornish and China Stone; the produce or manufacture of the United Kingdom; from the United Kingdom, to each country of destination, as registered during the month ended September 30, 1925:

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
FOREIGN.		
Russia	405	759
Finland	4,250	3,588
Esthonia	9	38
Sweden	1,998	2,957
Norway	2,355	2,989
Denmark (including Farōe Islands)	646	1,706
Germany	1,691	4,611
Netherlands	3,403	8,534
Belgium	6,166	9,510
Belgian Congo (including Belgian Ruanda and Belgian Urundi)	36	85
France	2,946	5,338
Portugal	6	25
Spain	1,227	4,181
Italy (including Fiume)	2,770	7,335
Siam	2	10
United States of America	27,613	56,933
Mexico	30	80
Brazil	25	105
Argentine Republic	1,297	1,862
BRITISH POSSESSIONS.		
Irish Free State	5	20
Union of South Africa (Cape of Good Hope)	—	1
British India, via:		
Bombay	1,904	7,877
Madras	21	85
Bengal, Assam, Bihar, and Orissa	59	236
Australia	21	90
Canada	1,442	1,729
Total (Foreign Countries and British Possessions)	60,327	120,684

China Clay Imports for September

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of September, 1925.

Countries whence consigned.	Quantities Tons.	Value. £
Belgium	12	12
Czecho Slovakia	10	74
U.S.A.	20	119
Channel Islands	100	180
Irish Free State	—	3
Total	142	388

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

Nine Months' Trade

LEAVING aside the all-important question of price, the turnover in China Clay and China Stone for the nine months of the present year exceeds in volume the quantity dealt with in any previous nine months since 1914. The figures for this year were 690,176 tons, of which 655,420 tons represented China Clay and 34,756 tons China Stone. The total exports of both China Clay and China Stone represented 470,564 tons, leaving 219,612 tons as the quantity absorbed by the home markets. The tonnage dealt with represents the high monthly average of nearly 77,000 tons. The monthly deliveries have fluctuated between 62,822 tons, recorded for the month of April, to 96,743 tons, which gave March the highest monthly total. The monthly total has only once fallen below 70,000 tons.

These figures take no account of Devon ball clays shipped by China Clay firms, the quantity of which in the nine months totalled 18,603 tons. Features of the deliveries this year have been the falling off of deliveries of China Stone and ball clay, and the substantial increase in the deliveries of China Clay. Many consumers who previously took larger quantities of China Stone and ball clay have reverted to the use of China Clay, now that the substantial break in prices has made it an advantageous raw material. The following record of the monthly deliveries of China Clay and China Stone (in tons) will be found interesting as showing the small quantities of China Stone delivered in comparison with China Clay, which maintains its predominance.

MONTH.	China Clay.	China Stone.	Total.
January ..	74,490	2,506	76,996
February ..	66,863	3,436	70,299
March ..	94,217	2,526	96,743
April	59,624	3,198	62,822
May	80,860	4,286	85,146
June	69,022	3,830	72,852
July	67,032	6,561	73,593
August ..	66,184	4,132	70,316
September ..	77,228	4,181	81,409

Pre-War Record Nearly Reached

The peak of production was reached in 1912, when 960,000 tons of China Clay and China Stone were delivered. Since then the highest total volume was in 1913, when 905,260 tons were delivered, and the next highest volume was in 1914, when 895,232 tons were dealt with. The nearest approach to that total since the war was in the "boom" year of 1920, when 864,360 tons were delivered. The total volume last year fell short of that quantity by only 6,000 tons. The monthly average this year has been over 76,000 tons, and putting the estimate for the last three months of the year at the fair figure of 70,000 tons per month, 1925 promises to be the best year in point of volume which the industry has experienced since the record trade of 1912. There is no hope of the industry reaching the great total of 960,000, but there is every prospect that the 900,000 mark will be touched if not exceeded by the end of this year. Several factors account for this steady increase in the volume of China Clay. There is the recovery and expansion of our markets in the United States, and the firm revival of demand from the Continent. The following figures of the quantities taken by our chief overseas customers during the nine months bear this out: United States of America, 408,095 tons; Scandinavia (including Finland, Sweden, and Norway), 47,893 tons; Belgium, 42,691 tons; Netherlands, 30,383 tons; France, 26,220 tons; Italy, 20,772 tons; Germany, 18,982 tons; India, 16,871 tons; Spain, 8,446 tons. A welcome feature of the export trade is the reopening of our markets in Germany, the quantity so far taken by that country this year being the largest since 1914. There is, moreover, every prospect, now that German industries are beginning to get on their feet and post-railway transport concessions in favour of Czechoslovakia no longer operate, that our pre-war markets with Germany, which were considerable (some 80,000 tons per annum), may be recovered. The 18,982 tons shown in the export lists as going to Germany does not represent the total quantity of English China Clays being absorbed by that country, because a considerable tonnage enters Germany by way of Antwerp and Netherland ports, and are thus included in the export figures for those countries. Another welcome sign in the development of our European markets is the increased quantities being taken by the Scandinavian countries: Norway is our best customer, Sweden coming next, and Finland third. With a more settled state in India, the exports of China Clay to that country are steadily improving, and there are prospects of further expansion.

Good Prospects in U.S.A.

The brightest spot in the export markets for China Clay is the United States of America, where the use of China Clay in paper-making is enormous and steadily grows, as is shown by the fact that already this year they have taken over 400,000 tons. Although certain industries interested in the production of domestic kaolins in America are becoming concerned at the growth of the markets for English China Clays in the United States, the fact that the biggest industries of America are able to obtain unlimited quantities of this valuable raw material at a moderate price, is a great boon to, and factor in developing those industries producing finished products for the American export trade, especially paper. The slow return of the French markets to their pre-war volume is no doubt largely due to the uncertain financial position of that country, which is seriously hindering the development of those industries in which China Clay was largely used before the war. The growth of China Clay markets in Italy is a welcome sign, and the increasing use of it in that country in the production of paper and cotton goods is very gratifying. There do not appear to be any signs of substantial growth in the direct Canadian markets for China Clay, but this may be partially explained by the fact that the Canadian paper mills, many of which have American interests, draw their supplies through American ports. There is no lack of proof that the development of the paper industry in Canada accounts for some of the expansion in the American demand for our China Clays. Great as is the volume of business now being done by China Clay producers, there is undoubtedly still considerable scope for the expansion of the demand which should follow from the industrial recovery of France and Germany. More extensive publicity given to the value of China Clay as a raw material, particularly stressing new uses, would be invaluable.

China Clay Prices and Their Relation to Production

Our contributor gives a practical survey of current conditions in the China Clay industry, outlines the essential relations between China Clay production and the determination of prices, and makes definite suggestions as to the policy of the proposed new association in the China Clay industry.

ENOUGH has been written in technical journals and the local press serving the China Clay producing area since September, 1924, on the fall in the prices of common clays to fill a good-sized volume. The general tendency of the criticism has been to deplore the fall in prices and to condemn the policy of unrestricted output and unrestricted competition which China Clay producers continue to pursue.

In the process of the development of many China Clay mines, the clay first produced is usually stained by water percolating from the surface through the subsoil to the clay, Generally, but by no means invariably, the deeper the mine the whiter the clay. Since a China Clay mine is roughly basin-shaped, a large amount of overburden must be removed all round to prevent soil, etc., falling into the pit and contaminating the clay. If the clay for some distance underneath the overburden is stained, this also must be removed by washing it away separately and the sides of the mine made perfectly safe before commencing to wash white bottom clay. Unless this is done the continuous working of the bottom will inevitably result in a "runner"—*i.e.*, the sides of the mine will slide or fall into the pit, with disastrous consequences if the "runner" consists of overburden or stained clay. It is usual in a good many mines to wash away a few thousand tons of stained clay before proceeding with the production of white clay. If the bottom clay only is white the effective washing area for white clay becomes more and more restricted as the mine is deepened. The bottom washing area, and consequently the production of white clay, can be increased only by removing overburden and any stained clay above it. Hence in the normal development of a China Clay mine the chances are that the proportion of common clay produced is comparable with that of best clay, and, taking a broad view, what is typical and true of one mine can be applied without misrepresentation to the industry as a whole.

Common Clay Production

There is another fruitful source of common clay. Very often a lode carrying stained clay on each side of it is encountered running straight through the heart of a white clay bed. When the lode is small and the stained clay is localised near the lode, the lode and stained clay are usually dug out together and washed separately from the white clay. This procedure is not always practicable, especially if the stained area is extensive, so that white and yellow clay have to be washed together, be the resulting sample what it may. It is sometimes necessary to wash through a considerable mass of yellow clay to reach whiter clay on the same level, and generally speaking the producer goes for his white clay even if it means washing thousands of tons of inferior clay in doing it.

If development is to be continuous, the common clay must be disposed of as quickly as it is dried, because storage room is limited. If the prices of common clays are reasonably low the producer can clear his stocks to make room for better clay, but if the controlled price is high, stocks of this class accumulate and become an embarrassment. Production must cease until they are disposed of.

At the moment, many producers with mines which yield common clays only are finding it difficult to make both ends meet, while those who have both best and common to sell make up on best clays any losses on common. It would appear sound policy for the projected new association which, if and when formed, is going to make Cornwall a land fit for clay producers to live in, to consider fixing only the prices of those clays which are to-day selling at 25s. and upwards per ton, leaving the more common to look after themselves. The prices of best clays should remain at their present profitable level to ensure a fair return for expenditure and to compensate producers for any loss on the commoner uncontrolled clays.

Common clays at the present low prices are displacing domestic clays in many countries, but any very considerable advance in price would give an immediate impetus to the use of foreign domestic clays and the exploitation of new sources. Common clay must be cheap and the price flexible to enable it to compete with domestic clays. Some producers, to avoid loss on low grade clays and to tide over a period of financial stringency, such as the present transition period in the China Clay industry, are producing only best clays. This may continue for a limited space of time, but such a policy cannot be pursued indefinitely, because, sooner or later, at the present rate of production, the development and extension of their mines will compel them to wash a certain amount of common clay.

Fixing Prices

For the many reasons stated it is obvious that if the amount of best clays produced is to be increased, or even maintained, side by side with it common clay must be produced and sold. Producers who have a continuous demand for the highly profitable best clays, but limited storage accommodation, will, while the prices of low-grade clays are not controlled, accept low prices for their common clays to effect a ready sale and rapid clearance of the storage space to make room for the preparation of profitable clays. This temporarily depresses the market for common or low-grade clays. Producers of such clays only, then refuse to produce and sell at a loss. Production ceases or is curtailed. The supply does not meet the demand, and then prices automatically rise, but only to such an extent as the limitation of the supply justifies. Hence it appears that prices of best clays may be artificially fixed and maintained, but that the prices of common or low-grade clays must of necessity be subject in greater or less measure to the economic law of supply and demand, and if artificially fixed by an association of producers, can only be fixed at such a level as may be justified by factors governing production or by the market demands and conditions throughout the world.

It would seem fairly certain that prices of low-grade clays have turned the corner, owing to heavy curtailment of production and that they will rise to a certain extent, but they will always be influenced by the supplies available when purchasers desire to buy. The indications are that buyers of common or medium clays who want to ensure supplies for a long period ahead had better contract for such supplies without undue delay. At the same time there appears to be no possibility of any association being able to fix arbitrarily fancy prices on such grades.

E. J. L.

Important Kaolin Properties in Georgia

MR. FRANK LOWSON, of Frank Lowson and Co., accountants, 815, 15th Street, Washington, D.C., informs us that he has bought large kaolin properties in Georgia. He has now practically completed the acquisition of the properties, when he will own a total of 1,250 acres with a 50-year lease on 400 more. Of the 1,250 acres, 550 are on the lowland and 700 are on the upland, with about half a mile of right of way between the two. The Southern Railway to Brunswick runs through the property for about 3,000 feet, and there is 600 feet of siding thereon. There is plenty of water well adapted for manufacturing purposes. Of the high ground, it is estimated that something between five and six hundred acres contain a very high grade of kaolin China Clay. It is estimated that there are at least 25 million tons. He is informed by responsible authorities that it is "the cream of Georgia clay." Mr. Lowson states that "if any of the British companies want to do business on this matter, it would be well for them to take action very soon."

New Paper Works

CHINA Clay producers will be interested in the announcement that the purchasers of the Hartlepools Paper Works, which have been closed since March, 1924, propose to carry out extensive alterations and improvements, and the mill is to be restarted early next year.

The Formation of Colloids

Medical Application of China Clay

AT a recent St. Austell Rotary Club luncheon, Rotarian E. J. Lewis gave an interesting paper on "Colloids." Dr. W. Gilchrist, president, was in the chair.

By means of crushing and grinding, said Mr. E. J. Lewis, ordinary coarse matter could be broken up into very minute particles, and by carrying on this process of subdivision, there was a limit of fineness beyond which it was impossible to go. Since the small particle visible under the microscope was about one fifty-thousandth of an inch, and the smallest particle with which he would deal, one fifty-millionth of an inch, there was a considerable range of subdivision to choose from. He was concerned with only those particles which were too small to be seen with a microscope, and much larger than molecules or atoms. The particles in that range were colloids, and the mixture resulting from the placing of millions of those particles in water, oil, or any other liquid, was called colloidal.

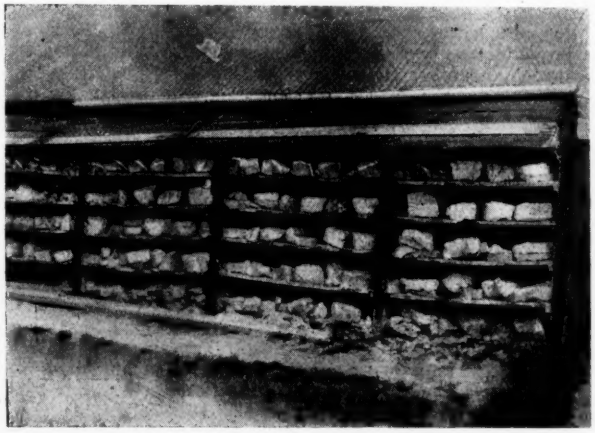
Salt water had the effect of making colloids coalesce, coagulate, and precipitate, and alum would also make colloids settle. Some colloids had the peculiar property of combining with water to form solid substances. The chemistry of colloids was yet in its infancy, said Rotarian Lewis. Many life processes and reactions had been produced by chemists, who had taken lifeless material, built up complex substances, and reproduced processes which occurred daily in living things, such as plants and animals. Not only had human phenomena been explained, but colloid chemistry had been of great service to industry and business.

During a discussion Dr. Gilchrist produced a box of what in the chemical world was known as colloidal clay, produced from China Clay, which was used in the treatment of certain forms of internal complaints. It was also used as an injection.

Rotarian Lewis said that the term colloidal was a trade term given to China Clay mostly of the ground variety, there being very little colloidal China Clay in the chemical sense. The test was its permanent suspension in water.

The Air Method of Drying China Clay

IN some parts of the clay districts of Cornwall the old air method of drying China Clay is still adopted in one or two of the smaller works, while in some others it is auxiliary to the modern method of drying by heat. As here illustrated, the China Clay in its wet, soft state is placed in little piles upon a series of wooden shelves erected in a roofed building open at the sides. In this way it is exposed to the air and sun and dried, without any fuel cost, in from two to seven days, according to the drying qualities of the atmosphere. Where time is not of primary consideration and the output is not large, this method ensures low production costs, and the clay so dried is said to possess certain qualities not shown by China Clays which have been rapidly dried by artificial heat. As a ton of coal is required to dry ten to fourteen tons of China Clay, the saving in fuel costs by this method is considerable.



The Unemployment Problem

St. Austell Council Propose Dole Alternative

NOVEL proposals in connection with the present unemployment insurance system have been made by the St. Austell Rural District Council for consideration by the Government, and details have been sent to all the Cornish Members of Parliament.

At the meeting of the Council, Mr. F. W. Jenkin presided, and the Highways Committee reported that, as instructed, they had considered the effect of the dole system, and were of opinion that very beneficial results would accrue if all recipients of the dole were compelled to do some work. They recommended that the Council urged the Government to empower local authorities to receive and administer the dole for the employment of the recipients in some remunerative work, and also that special attention be given to the capitalisation of the dole.

Mr. F. Davis agreed that it would be a good thing if the money now given away in doles could be used in some remunerative work, but if the money was to be paid to employees in aid of wages for work provided, it would be subsidising some employers and not others.

The chairman pointed out that the question of the money being paid over to ordinary employers was never contemplated by the Committee.

Mr. E. B. Vian, a master China Clay cooper, while admitting that there were people who wanted to adopt an easy way of qualifying for the dole, there were men, in the China Clay coopering trade, for instance, who, with employers, had been paying unemployment insurance money, and had never had a penny benefit. Were they to say to these men when they were out of work "Although you have paid all this money you must do something for it now you want relief"? The Government would probably remedy the abuse.

Mr. R. Varcoe said it would have been better in that district, where they had had so much unemployment, and had expended between £200,000 and £300,000, if the Government had paid over to them the money paid away in doles. Dr. Marshall expressed his entire agreement with this view.

The Committee's recommendations were agreed to.

What is China Clay?

THE New York journal *Chemicals* conducts a technical service department, and China Clay producers will probably be interested in this recent question and answer which appeared in their columns:—

The question asked what were the differences between China Clay and Terra Alba, and the uses of Terra Alba.

The reply, in typical phrasing, included the following:—

"This term—the Latin for 'white earth'—like several similar expressions, handed down from the days of mediæval chemistry, is unnecessarily forced to work overtime, and there are no philological trades unions to come to its rescue.

"The kaolins are white-burning clays, consisting chiefly of hydrous aluminium silicate, with little or no iron oxide. There are two principal groups. The non-plastic varieties are used for porcelain, china, white-ware, pottery, high-grade tile, and paper manufacture. The annual consumption is about 70,000 short tons. The plastic varieties are often termed ball clays, and paper clays. They contain more fluxing impurities than the preceding. 'Ball clay' is often used more specifically to designate plastic clays of high tensile strength and bonding power. They are extensively used as an ingredient of high-grade tile and white-ware mixtures, to give the body sufficient plasticity and binding power. The consumption in 1923 was 97,068 tons.

"The term 'paper clay' is usually applied to highly plastic white clay quite free from sand. Vast amounts are employed as a filler and coating in the manufacture of paper. In 1923 the consumption was 102,732 tons.

"All of these white clays are occasionally termed 'terra alba' in trade, and popularly.

"Apart from the leading uses indicated above, considerable amounts are consumed in the production of electrical fixtures, sanitary ware, chemical porcelain, oil cloth, pigments, asbestos wares, cement, crayons, munitions, fire brick and block, greenhouse supplies, phonograph records, and other minor industries."

China Clay Notes and News

Collapse of China Clay Coopers' Strike

The China Clay coopers who came out on strike last month returned to work after a week at the instance of the Workers' Union, and without securing the demands for more pay per cask. They were told by their employers that if they left work they would not be taken back, and many therefore declined to strike.

Local Unemployment Figures

According to official returns, there are at present 2,425 unemployed in the Mid and West Cornwall area. The detailed figures are: Redruth, 417; Camborne, 458; Falmouth, 318; Fowey, 68; Hayle, 277; Helston, Newquay, 74; Penzance, 361; Perranporth, 27; St. Austell, 204; St. Columb, 25; St. Just, 64; and Truro, 101.

First Concrete Road for Cornwall

The distinction of having the first concrete road in Cornwall will belong to the St. Austell district, where, at Mount Charles, between the town and Charlestown, there is to be laid a stretch of about a quarter of a mile, and a tender for £5,966 had been accepted. It is to be a reinforced concrete road, and the cost is being met by the County Council.

Penzance Port Development

Penzance Town Council has authorised the Quay Committee to negotiate with Coast Lines, Ltd., who submitted proposals for the erection of a shed costing £3,700, on the north arm of the floating dock, subject to there being no burden on the rates. Captain Lugg said that Coast Lines had offered to find the money, to be repaid in the same manner as was done in connection with the building of China Clay sheds.

Duke of Cornwall and Cornish Bandsmen

The following reply was received by the Hon. Secretary of the West of England Bandsmen's Festival (Mr. F. J. P. Richards, of Bugle) to a message of welcome addressed to the Prince of Wales:—"I am directed by the Duke of Cornwall to thank you very much for the hearty and loyal welcome home conveyed by you on behalf of Westcountry Bandsmen and the Festival Committee.—WALTER PEACOCK."

New Motor Ambulance for St. Austell

The St. Austell district is to have a new and up-to-date motor ambulance at a cost of about £725. The Honorary Treasurer, Mr. G. H. Grenfell, who is associated with English China Clays, Ltd., has secured this amount within a few pounds, and the Voluntary Aid Detachment are keenly appreciative of this great encouragement. When the new ambulance arrives it will be exhibited publicly. Mr. Grenfell is to be congratulated on his magnificent effort.

Proposed Closing of St. Austell Level Crossing

The Great Western Railway has informed the St. Austell Urban Council that they contemplate closing the level crossing at St. Austell Station and substituting a footbridge. The crossing is very little used for China Clay traffic because the gradient from the west end of the town is too steep and winding, but it is largely used for the transport of coal from the station to the China Clay works in the vicinity. If the China Clay industry have any representations to make to the G.W.R. on the subject, they should do so without delay.

Fowey Harriers' Good Sport in Clay District

Early last month the first meet of the Fowey Harriers in the China Clay district took place at St. Dennis, according to ancient custom, under the joint mastership of Lady Vivian and Miss Ivy Martyn, when Mr. George Mitchell brought 16 fine couple. There was a good field and the weather was fine. In addition to the joint Masters there were present:—Mrs. Bryant, the Hon. Miss D. Vivian, Mr. and Mrs. Colenso, Lieut. Trounsell, Sir Henry Nelson, Messrs. J. Hoyle, Clark, Tremain (St. Ewe), Rowe, Rail, Mitchell (Bodmin), G. Morcom, Richards, Snell (St. Stephen's), Henry Yelland, W. T. Kellow, J. Best Spry, Gill (Gothers), and Rundle (Penarwyn).

China Clay Works Withdrawn

There was a small attendance at the St. Austell Lecture Hall last month for the sale by auction by Herbert Rowse and Son of the Cornish Meledor China Clay Works. The particulars of sale showed that the area was 155 acres, held on a lease for 31 years from Christmas, 1918, the dues payable were 1s. 3d. per ton China Clay and 9d. per ton mica clay, merging into a maximum rent of £100 per annum. The works commenced output in October, 1921, and in November and December of that year 538 tons were disposed of at 43s. per ton. Since then the following sales have been made:—In 1922, 5,491 tons, for £11,737; 1923, 5,206 tons, for £9,665; 1924, 4,715 tons, for £8,913; 1925 (January to July), 3,794 tons, for £3,980. There was only one bid, by Mr. N. F. Bellamy, for £1,000, and the property was withdrawn. Bird and Bird (London) and Coodes and Giffard (St. Austell) were the solicitors for the vendor, Mr. James Scott, mortgagee.

Canals Needed in Cornwall

At a meeting held under the auspices of the Workers' Education Association, at Truro, it was decided to hold a series of 12 lectures in connection with the University of Exeter, to be conducted by Mr. C. G. Henderson, B.A. (lecturer to the College in Cornwall). Mr. W. Rose, of the China Clay firm of North and Rose, presided. Mr. Henderson then opened the course on the subject of "The Making of Modern England, 1770-1850." He said that one improvement carried out during the period reviewed was the Bude Canal to Launceston. An extraordinary canal was designed by a clergyman at Newquay to start at the cliff at St. Columb Porth, running to St. Columb Minor, and down the valley to Mawgan Porth, to carry seaweed as a fertiliser. All the partners went bankrupt before they got the water in, but nevertheless it was said that no country in the world stood more in need of water canals than Cornwall. Professor Moberly, principal of Exeter University College, took part in the discussion.

Honour for Clay-worker's Son

The President of the Board of Education has made appreciative comment on the knowledge he recently gained on a visit to the St. Austell County School of the successful achievement of Mr. A. L. Rowse, who has been elected a Fellow of All Souls' College, Oxford. Lord Eustace Percy regards him as a brilliant example of a rapid rise from the elementary schools. Mr. Rowse is not yet 22 years of age, and went to Oxford with a scholarship from the elementary and through the secondary school. He is the son of a labourer in the China Clay district, whose wages did not exceed two guineas a week, and he has won his way by sheer ability and hard work. Mr. Rowse is regarded as one of the men whose career justifies the policy, which the Board of Education is seeking to enlarge, of providing the open road for brains while adjusting educational opportunity to capacity for benefiting by it. Mr. Rowse, senior, has been for twenty years in the employ of John Lovering and Co., at their Carclaze Works.

St. Austell Rotarians and Progress

At St. Austell Rotary Club luncheon at Richard's Restaurant on Wednesday, October 21, Rotarian W. Gilchrist presiding, Rotarian S. P. Bunn, in an address on "Putting pep into Rotary," advocated the rendering of service in other directions as well as in the furtherance of the interests of business and helping philanthropic and charitable causes. He suggested the discussion of such political questions as Communism, trade unionism, unemployment, Fascism, co-operation, prohibition, and foreign policy, so that they might be spurred on to think on those and kindred subjects, and get a clear conception of what they thought on such questions, and help in the moulding of opinions. Thus might they be better able to render service in combating the half-baked theories and opinions that prevailed.

He also advocated the Club taking a hand in the fostering of progressive ideas in the municipal and business life of the locality, and recommended the Urban Council to take up the question of one-way traffic through St. Austell to relieve the serious congestion that now occurs.

Clayopolis Band Finances

At the annual meeting of the St. Austell Town Band, Mr. E. W. Galley (of English China Clays, Ltd., Accountants' Department), chairman of the committee, presided, and Mr. E. H. Williams (North Goonbarrow China Clay Co., Ltd.) presented the balance-sheet on behalf of the treasurer, Mr. R. J. Penrose. He said that they had begun with a balance of £38 18s. 2d., and had finished up with £3 11s. 11d. in hand. The principal items of income were :—Subscriptions, £10 9s. ; concerts, £50 10s. 2d. ; whist drive and dance, £22 10s. 2d. ; annual fête, £83 16s. 11d. ; West of England Bandsmen's Festival, £5 ; collection for the Bugle contest, £13 3s. Bringing forward the balance from the previous year, the total receipts were £227 5s. 7d. Among the items of expenditure were :—Bandmaster's salary, £100 ; printing, stationery, and advertising, £21 16s. 9d. ; public rooms for concert, £15 0s. 6d. ; bandsmen's expenses, £16 0s. 4d. ; travelling expenses, £10 2s. 2d. ; Bugle Festival expenses, £10 6s. 6d. ; total expenses, £223 13s. 8d.

China Clay Company Director's Will

Mr. David Phillips, of Trewoon, St. Mewan, who died on May 9, left estate of the gross value of £9,659 with net personalty £9,545. Probate of the will has been granted to his sisters, Mrs. Julia Truscott, of Trewithen, Sticker, St. Stephen's-in-Brannel, and Miss Kate Phillips, of Trewoon, to whom, in equal shares, he left all his property. Mr. Phillips was a director, with Mr. E. J. Hancock, in some of his China Clay undertakings.

Mr. Joseph Vivian Thomas, of Trevidren, Penzance, solicitor, a former alderman and mayor of Penzance, and also a director of the Geevor Tin Mines, Ltd., who died on July 17, aged 55 years, left estate of the gross value of £31,348, with net personalty £28,557. Probate has been granted to his widow, Mrs. Edith Mary Thomas, to whom he left all his property absolutely. Mr. Thomas's services were much sought after in Cornwall, and he was retained by the China Clay Employers' Federation when the Joint Industrial Council of the industry could not agree on wages claims.

Working Man Mayor of Fowey

Alderman John Green Lewarne is the new Mayor of Fowey. Born at Fowey in 1876, the Mayor is employed as a cranesman on the Great Western Railway China Clay docks at Fowey. He was elected to the Borough Council on its reformation in 1913, being third on the poll of 30 candidates, and was the youngest member elected. Mr. Lewarne has since served the borough for ten years as councillor and for two years as alderman. He has held the chairmanship of the Water Extension Committee, and is now chairman of the Housing Committee, for which he has worked strenuously. A three years' term of his office he also spent as Borough Overseer. He mobilised with the Fowey Royal Engineers (T) at the outbreak of war as sergeant, attaining C.S.M. rank in February, 1915, and served in France and Belgium until 1919. He holds four service medals ; he also received the Royal Humane Society's medal and certificate for saving life from drowning in 1896. Alderman Lewarne is senior deacon of Fowey Lodge of Freemasons, and is district secretary of the National Deposit Friendly Society. He has been a church bellringer for 20 years. The Mayor is the youngest member to attain the honour since the restoration of the Charter.

China Clay Compensation Case

At St. Austell County Court last month Judge Gurdon delivered judgment in the compensation case heard at the August Court, in which William James Runnalls, clay labourer, St. Dennis, sued the United China Clay Co., Ltd., for £300 compensation in respect of the death of his son, Idris Roy Runnalls, 18, who was killed in the engine house at Western Clay Works, St. Dennis, in October last year as the result of the explosion of a carbide generator with which he was experimenting, it was alleged, in order to obtain a better light. (The case was fully reported in the *China Clay Trade Review* of September 19.) The Judge said that he would not be justified in inferring that the deceased youth was at the time of the accident trying to get the carbide generator to work because of a defect in or insufficiency of the light given by the oil lamp. It might have been so, but it was a matter of pure speculation. If a defect had existed, the boy would have mentioned it to his father. That view of the evidence disposed of the case. If lighting was insufficient it was not the lad's duty to supply himself with more without reference to superiors. Any award must be in favour of the company, and if they asked for costs they must have them. He said that if the theory was admitted that a workman could do anything without instructions, there was no limit to what he might do.

China Clay Fatality

An inquest was held at Stenalees Institute last monthby the Coroner, Mr. M. F. Edyvean, with a jury, into the death of John Horton, 40, clayworker, of Stenalees, who met with a fatal accident at the South Caudledown works of H. D. Pochin and Co., Ltd. William Edward Harris, Bugle, clayworker at the South Caudle works, said that Horton was engaged in putting in a pair of rails at the bottom of the burden pit. He filled a wagon and sent it up to witness to be emptied. The wagon was worked by a wire rope and chain off the drum of the engine, and there was a crook joining the rope to the wagon. On the morning of the accident witness sent a wagon down. It went to the end of the rope, stopped dead, and unhooked. It then ran away, and witness shouted to Horton. Horton could have seen the wagon coming down, but at the time he was kneeling to put in a rail on the track. As the wagon went down, the top left the bed and knocked him into the pit.

Replying to Mr. King (H.M. Inspector of Mines and Quarries), witness said he had had no previous trouble with the wagon. It was usual to put the brake on the drum for safety, but a bell for signalling to the driver was not used.

Henry Osborne, Stenalees, driver of the engine, said the brake was on the drum, but he could not see if the rope became unhitched. The hook used on this wagon was the same as was used in other clay pits.

Dr. R. S. Olver, St. Austell, said that Horton had sustained very severe injuries, quite sufficient to cause immediate death.

Mr. King said that it was rather a pity more of the clay workers did not try to avail themselves of the local first-aid classes, and Captain Tabb was apparently the only ambulance man on the works.

The jury returned a verdict of accidental death.

St. Austell's £50,000 By-pass Road Scheme

The reason for the delay, which has caused considerable comment in the China Clay district, in commencing the Ministry of Transport's and local authorities' £50,000 joint scheme for a by-pass road to skirt St. Austell, was explained at the last meeting of the Mid and West Cornwall Unemployment Committee at Redruth.

Mr. F. C. Bond, secretary, reported that the County Surveyor had written that he was not in a position to state definitely when work would be commenced. He (Mr. Bond) understood that some delay was being caused through difficulty in acquiring certain land.

The Chairman, Sir Arthur Carkeek, said that he was not going to cast any reflection on the landlords of Cornwall : they had as a rule treated the county authority remarkably well, often generously, but there had been two or three exceptions. He believed the St. Austell scheme, which would absorb practically the whole of the unemployed in the St. Austell district, would be started next week but for a difference of opinion with regard to the value of certain land required for the scheme. "I do not think that it is right," said Sir Arthur, "that a man should be allowed under any law to stand in the way of an improvement of this kind." He was in favour of arbitration. Mr. J. H. Bennetts (Workers' Union) expressed similar views.

At a later meeting of the Council Councillor Smith said that the landowners had met the Council most reasonably, and it was only fair to state that the road had been held up because of the attitude of those concerned in about three-quarters of an acre. The Chairman (Mr. T. H. Williams) made the welcome announcement that the Clerk (Mr. G. B. Dobell) and he had effected some settlements, and there was only one more landowner to settle with.

China Clay Merchant's Marriage

Presentation from China Clay Workers

THE marriage of Captain Algernon Henry Moreing, M.P. for Camborne Division of Cornwall, elder son of Mr. and Mrs. C. A. Moreing, of 11, Mount Street, Berkeley Square, London, and Miss Dorothy Maude Holman, elder daughter of Mr. and Mrs. James Miners Holman, of Rosewarne, Camborne, took place last month at St. Margaret's Church, Westminster. The Rev. R. E. Sexton officiated.

The bride was given away by her elder brother, Mr. J. Leonard Holman, and was attended by Miss Patricia Holman, her niece, Master John Lean, her nephew, and the Misses Betty and Joan Holman, and Piona Pembroke-Wicks. Mr. Clive Wilson was best man.

After the ceremony, a reception was held at Claridge's Hotel, and among the guests were Mr. and Mrs. C. Algernon Moreing, Mr. and Mrs. J. M. Holman, Captain A. Moreing, Mr. and Mrs. Percy Holman, Mrs. John Holman, Mr. and Mrs. Treve Holman, Mr. Kenneth Holman, Mrs. P. M. Holman, Sir Alan and Lady Burgoyne, Sir Tudor and Lady Walters, Major and the Hon. Mrs. Goldman, Mrs. Charles Agilvie, Mrs. Burgess (Camborne), Mr. and Mrs. Booth Knox, Mrs. Pembroke Wicks, Captain and Mrs. R. H. Timmis, Mrs. Dyke Wright, Miss de Villiers, Mrs. Rayleigh, Mr. and Mrs. Vivian, Mr. and Mrs. Paull, Major and Mrs. Morrogh, Mrs. Noel Clifton, Mr. and Mrs. Hoghton, Major and Mrs. Rushbrooke, Mr. and Mrs. Trewhella (St. Ives), Mr. G. Strickland, Mr. and Mrs. W. White (Camborne), Mr. and Mrs. Nancorrow, Mr. and Mrs. Gardiner, Mr. and Mrs. Arthur Thomas (Camborne), Mr. and Mrs. R. S. Reed, Mrs. and Miss Moreley, Mr. G. Pilcher, M.P. (Penryn-Falmouth Division), and Mrs. Pilcher, Mr. and Mrs. Walter Payne, Mr. and Mrs. MacLeod, Mrs. C. Thomas, Mr. D. Thomas, Mrs. Lean, Mrs. Moir, Mr. and Mrs. W. Payne, Mr. and Mrs. I. Price, and Mr. Godfrey.

For many years Captain Moreing, besides being connected with Tehidy Minerals, Ltd., has been prominently associated with the firm of Bewick Moreing and Co., general managers of Cornish Kaolin, Ltd., the proprietors of the Glynn Valley China Clay Works, near Bodmin, and the Halviggan China Clay Works, near St. Austell, and he is a frequent visitor to St. Austell. Captain Moreing has been largely responsible for the progressive policy under which the Cornish Kaolin, Ltd., has been developed. He was the recipient of a silver coffee service, presented by the superintendent, Mr. R. M. Richards, the staff, and employees of the Glynn Valley and Halviggan China Clay Works. The honeymoon is being spent at Biarritz.

Local Journalist's Wedding

AN interesting wedding took place at St. Leonards Church, Exeter, on Monday, November 16, when Mr. Stephen Percy Bunn, of Penworth, St. Austell, was married to Mrs. Nellie Coles, widow of the late Mr. R. V. Coles, of Exeter and Bristol. The bride was given away by her father, and the bridegroom was attended by his brother-in-law, Mr. E. W. Mosedale, of Birmingham. The Rev. R. L. Collins officiated. After the ceremony, the guests were entertained at Déller's Restaurant. Mr. and Mrs. Bunn subsequently left for London for the honeymoon. The bridegroom is a well-known west of England journalist at St. Austell, where he is the local manager of *The Cornish Guardian*, correspondent of *The Western Morning News*, and representative of the China Clay Trade Review Section of THE CHEMICAL AGE. His first wife died in 191

China Clay Imports for October

A RETURN of the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland during the month of October, 1925, records one consignment, from the Channel Islands, of 140 tons, value £240.

Possibilities of Ukrainian Kaolin

SAMPLES of Ukrainian kaolin, according to reports, were sent to Germany some months ago for laboratory experiments, which showed that after treatment high quality kaolin resulted, from which the finest porcelain, both biscuit and glazed, can be manufactured. The Supreme Economic Council is aking measures for the organisation and development of trade in kaolin.

Canada's Clay Resources

China Clay Very Limited

AN official survey of Canada's clay resources shows that there are large fields of the commoner grades of clay, but China Clay producers in Cornwall should still find a good market in Canada.

Clays and shales suitable for making common brick and high-grade face brick are plentiful and widely distributed in Canada. Bricks produced are not only of good strength and form, but also embrace a wide range of colour, and are manufactured in an assortment of surface textures. There is little need for importing any building brick into the country. As much cannot, however,be said for the special purpose clays, since their distribution in Canada is rather limited. Nevertheless, there are large and valuable deposits which are important resources. Fireclays occur in British Columbia, Alberta, Saskatchewan, Ontario, New Brunswick and Nova Scotia. Firebrick and refractory shapes are made from local clays in British Columbia, Saskatchewan and Nova Scotia. Pottery clays of very good quality are obtainable in Alberta, Saskatchewan, New Brunswick, Nova Scotia, and Prince Edward Island. Those of New Brunswick and Prince Edward Island, and also some from Nova Scotia are red burning and produce a good body for art pottery while in Alberta, Saskatchewan and Nova Scotia, there are deposits of light-coloured stoneware clays. Deposits in Nova Scotia are being worked as a source of raw material for a pottery at St. John, New Brunswick.

High Grade Ball Clay

In the southern Saskatchewan field a high-grade ball clay is also being worked, and shipments are made to various points in Canada. This clay is refractory, highly plastic, and burns to a very good white. It may be regarded as one of Canada's most valuable clay resources. Kaolin or China Clay is known to occur in but few localities in Canada, and has only been produced on a commercial scale at one point—namely, near St. Remi, in the province of Quebec. A deposit in northern Ontario has received considerable attention recently, but until railway facilities are available it cannot become a producer. In British Columbia a deposit, apparently of commercial value, occurs near Williams lake. Other deposits of kaolin are on record, but such information as is available concerning them does not warrant including them as potential producers.

October Deliveries of China Clay

Second Best Month of the Year

TRADE by China Clay firms made a further advance in October, when the total of 89,682 tons in all three classes represented the second largest monthly total for the year. March figures are first, showing 98,598 tons.

October trade showed an increase of over 6,000 tons on the September total. Fowey was responsible for nearly 5,000 tons of the increase, and Charlestown for over 1,000 tons, the latter port, with 7,026 tons, creating another monthly record. Par figures declined by nearly 500 tons. The total for the ten months is within 529 tons of 800,000 tons, making 1925 the best post-war year in point of volume, and exceeding last year's tonnage for the corresponding period by over 46,000 tons. The following are the detailed figures :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
PORT.	1925.	1924.	1925.	1924.	1925.	1924.	1925.	1924.
Fowey	60,969	64,037	4,234	3,583	5,680	2,708	70,883	70,328
Charlestown	7,026	5,597	—	—	—	—	7,026	5,597
Par	4,591	3,876	1,135	100	—	—	5,726	3,976
Penzance	550	—	—	—	—	—	550	—
Plymouth	442	1,567	36	10	—	113	478	1,690
Falmouth	534	—	—	—	—	—	534	—
By rail	4,485	5,120	—	—	—	—	4,485	5,129
TOTALS.	78,597	80,197	5,405	3,693	5,680	2,821	89,682	86,711
September	77,228	73,307	4,181	4,368	2,015	3,342	83,424	81,017
August	66,184	61,681	4,132	6,009	2,720	1,970	73,036	69,660
July	67,032	68,951	6,561	5,347	2,787	8,005	77,390	82,303
June	69,022	58,504	3,830	3,310	2,619	3,076	75,471	64,890
May	80,860	82,405	4,286	3,363	1,825	2,859	86,671	88,357
April	59,624	75,311	3,198	4,651	1,818	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,056	3,978	3,050	1,567	80,046	62,231
TOTAL, 10 months	734,117	683,477	40,061	40,446	24,283	29,412	799,471	753,335

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—October, 1925

Arrivals

Date	Vessel	From
Sept. 30	*Stronsa Firth*	Portsmouth
Sept. 30	*John Gibson*	Falmouth
Oct. 2	*La Revanche*	Cardiff
Oct. 2	*Marena*	Newport(Monmouth)
Oct. 2	*Treleigh*	Portreath
Oct. 2	*St. Enoch*	Truro
Oct. 2	*Camw*	Scilly
Oct. 7	*Rosalie*	Poole
Oct. 9	*Martinet*	Plymouth
Oct. 12	*Foamville*	Brest
Oct. 13	*Snow Queen*	Falmouth
Oct. 14	*Millocrat*	Falmouth
Oct. 14	*Conescrag*	Truro
Oct. 14	*Lady Agnes*	Pentewan
Oct. 15	*Cornelia*	Plymouth
Oct. 15	*Rowa*	Trangsund
Oct. 16	*Jane Banks*	Plymouth
Oct. 16	*Irish Minstrel*	Cardiff
Oct. 16	*Zampa*	Trangsund
Oct. 17	*Delos*	Rafso
Oct. 18	*Adam Smith*	Plymouth
Oct. 21	*Miriam Thomas*	Newlyn
Oct. 24	*Snowflake*	Mevagissey

Sailings

Date	Vessel	Destination
Oct. 2	*Stronsa Firth*	London
Oct. 5	*John Gibson*	Runcorn
Oct. 6	*Marena*	Barrow
Oct. 6	*Treleigh*	Preston
Oct. 6	*St. Enoch*	Larne (Ireland)
Oct. 6	*Camw*	Rochester
Oct. 7	*Rosalie*	Antwerp
Oct. 13	*Martinet*	London
Oct. 13	*La Revanche*	Nantes
Oct. 14	*Foamville*	Rouen
Oct. 15	*Snow Queen*	Runcorn
Oct. 16	*Millocrat*	Liverpool
Oct. 16	*Jane Banks*	Runcorn
Oct. 16	*Conescrag*	London
Oct. 17	*Cornelia*	Wyborg
Oct. 17	*Lady Agnes*	London
Oct. 19	*Adam Smith*	Barrow
Oct. 21	*Miriam Thomas*	Preston
Oct. 28	*Irish Minstrel*	London
Oct. 31	*Rowa*	Granton
Oct. 31	*Zampa*	Christiansand(Norway)
Oct. 31	*Delos*	Grangemouth
Oct. 31	*Snowflake*	Runcorn

Fowey Shipping—October, 1925

Arrived.	Name.	Sailed.	Destination.
October 1, S.S.	*Kyanite*	October 3,	Swansea
October 1, M.V.	*Dronning Thyra*	October 10,	Raumo
October 2, S.S.	*Alice*	October 9,	Preston
October 2, S.S.	*Sambre*	October 13,	Passages
October 2,	*Mary Watkinson*	*	Newcastle
October 2, S.S.	*Primrose*	October 10,	Ridham
October 3, S.S.	*Edern*	October 9,	Birkenhead
October 5, S.S.	*India Maru*	October 28,	New York
October 5,	*Ryelands*	November 5,	Gravelines
October 5,	*Adelaide*	*	Runcorn
October 6, S.S.	*Fodhla*	October 13,	Antwerp
October 6,	*Happy Harry*	October 14,	Pentewan
October 6, S.S.	*Goodig*	October 14,	Brussels
October 7, S.S.	*Vechtstroom*	October 15,	Amsterdam
October 7, M.V.	*Isabel*	October 10,	Porthoustock
October 7, S.S.	*Pylades*	October 15,	Methil
October 8,	*Phyllis*	*	Genoa
October 8, S.S.	*Alder*	October 14,	Fleetwood
October 8, S.S.	*Falken*	October 17,	Kotka
October 9, S.S.	*Elisabet*	October 19,	Raumo
October 9,	*Zampa*	October 16,	Charlestown
October 9,	*Delos*	October 17,	Charlestown
October 9,	*Roma*	October 15,	Charlestown
October 9, S.S.	*Falmouth Castle*	October 15,	Runcorn
October 11, M.V.	*Dietrich Hasseldieck*	October 20,	Hamburg
October 11, S.S.	*Innisholm*	October 13,	Guernsey
October 11, S.S.	*Ohio Maru*	November 5,	Philadelphia
October 11, S.S.	*De Wadden*	October 14,	Charlestown
October 11, S.S.	*Brynawel*	October 20,	Garston
October 11,	*Englishman*	October 14,	Looe
October 13, S.S.	*Landport*	October 17,	Antwerp
October 13, S.S.	*Coaster*	October 17,	Greenhithe
October 14, S.S.	*Farfield*	October 15,	Swansea
October 14, M.V.	*Isabel*	October 31,	Charlestown
October 14,	*Lutt*	November 2,	Gothenburg
October 14, M.V.	*Henrich Luhring*	October 23,	Bremen
October 15, S.S.	*Esther*	October 24,	Antwerp
October 15, S.S.	*Overton*	October 21,	Birkenhead
October 16, S.S.	*Glenbrook*	October 17,	Par
October 16, S.S.	*Hayle*	October 20,	Par
October 16, S.S.	*Ewy*	October 22,	Wargan
October 18, S.S.	*Clara Monks*	October 24,	Bo'ness
October 18, S.S.	*Claretta*	October 23,	Weston Pt.
October 18, S.S.	*Pansy*	October 23,	Rochester
October 19, S.S.	*Dorset Coast*	October 24,	Birkenhead
October 19,	*Industry*	October 28,	Pentewan
October 19, S.S.	*Monksville*	October 27,	Preston
October 21,	*Husavik*	October 25,	Poole
October 22, S.S.	*Blush Rose*	October 27,	Runcorn
October 23, S.S.	*Cervantes*	October 28,	Genoa
October 23, S.S.	*Foamville*	October 28,	Fleetwood
October 25, S.S.	*Cornish Merchant*	October 28,	Rouen
October 25, S.S.	*Eskburn*	October 31,	Ridham
October 25, S.S.	*Wiedau*	October 30,	Hamburg
October 25, S.S.	*Shoreham*	October 31,	Weston Point
October 25,	*Kurt*	*	Stockholm
October 27, S.S.	*Falmouth Castle*	October 29,	Runcorn
October 28, S.S.	*Sturdee Rose*	October 31,	Preston
October 28, S.S.	*Katherine*	November 4,	Pentewan
October 29, M.V.	*Grietze*	November 4,	Gothenburg
October 29, M.V.	*Atlantic*	November 4,	Helsingborg
October 29, S.S.	*Farfield*	November 3,	Grimsby
October 29, S.S.	*Gouwestroom*	November 4,	Amsterdam
October 29, S.S.	*Camberway*	*	Brussels
October 30, S.S.	*Pengam*	*	Bilbao
October 31, S.S.	*Orchis*	November 4,	Ridham
October 31, S.S.	*Avanville*	November 5,	Preston
October 31,	*Englishman*	*	
October 31,	*Mount Blairy*	*	Runcorn

* In Port.

Par Harbour Shipping—October, 1925

Sailings

Date		Vessel	Destination
Oct. 2	S.S.	*Falmouth Castle*	Runcorn
Oct. 2	S.S.	*James Tennant*	Newcastle
Oct. 7	S.V.	*Fanny Crossfield*	Kirkcaldy
Oct. 7	S.V.	*Lucy*	Dunkirk
Oct. 13	M.V.	*Annie*	Plymouth
Oct. 14	S.V.	*Shortest Day*	Pentewan
Oct. 15	S.V.	*Henrietta*	Pentewan
Oct. 16	M.V.	*Elizabeth Drew*	Rochester
Oct. 17	S.S.	*Magrix*	Antwerp
Oct. 17	S.V.	*Hilda*	Antwerp
Oct. 17	S.S.	*Porthcarrick*	Rouen
Oct. 17	S.S.	*Treleigh*	Preston
Oct. 19	S.S.	*Tanny*	Avonmouth
Oct. 21	S.S.	*James Tennant*	London
Oct. 24	M.V.	*Cambourne*	Gloucester
Oct. 24	S.S.	*Glenbrook*	Rochester
Oct. 24	S.S.	*Velocity*	Newlyn
Oct. 28	S.S.	*Hayle*	Weston Point
Oct. 31	S.V.	*Duchess*	Runcorn
Oct. 31	S.V.	*Mary Sinclair*	London
Oct. 31	S.V.	*My Lady*	Glasgow
Oct. 31	S.V.	*Pet*	Rochester
Oct. 31	M.V.	*De Wadden*	London
Oct. 31	S.S.	*Millocrat*	Manchester

Arrivals

Date		Vessel	From
Oct. 1	S.V.	*Lucy*	Plymouth
Oct. 2	M.V.	*Annie*	Plymouth
Oct. 3	S.V.	*Duchess*	Poole
Oct. 8	S.V.	*Bulla*	Port Talbot

Oct.	8	S.V. *Hilda*	Newlyn
Oct.	8	S.V. *Two Sisters*	Southampton
Oct.	10	S.V. *My Lady*	Plymouth
Oct.	10	S.V. *Mary Sinclair*	Jersey
Oct.	10	S.V. *Pet*	Falmouth
Oct.	11	M.V. *Cambourne*	Helford
Oct.	11	M.V. *Elizabeth Drew*	Truro
Oct.	11	S.V. *Helena Anna*	Penryn
Oct.	13	S.S. *Magrix*	Teignmouth
Oct.	13	S.V. *Shortest Day*	Plymouth
Oct.	13	S.S. *James Tennant*	Goole
Oct.	13	S.V. *Henrietta*	Cowes
Oct.	14	S.S. *Porthcarrick*	Jersey
Oct.	14	S.V. *Flying Foam*	Falmouth
Oct.	15	S.V. *W. E. Gladstone*	Plymouth
Oct.	16	S.S. *Treleigh*	Portreath
Oct.	16	M.V. *De Wadden*	Charlestown
Oct.	17	S.S. *Tanny*	Penzance
Oct.	17	S.V. *Emily Warbrick*	Falmouth
Oct.	17	S.V. *Yealm*	Port Houstock
Oct.	17	S.S. *Glenbrook*	Fowey
Oct.	18	S.S. *Velocity*	Newlyn
Oct.	21	S.S. *Hayle*	Fowey
Oct.	24	M.V. *Katie*	Newlyn
Oct.	24	S.V. *Dispatch*	Falmouth
Oct.	25	S.V. *Pearl*	Falmouth
Oct.	25	M.V. *Hope*	Port Houstock
Oct.	25	S.V. *Gwendoline*	Plymouth
Oct.	27	S.S. *Millocrat*	Penryn
Oct.	28	S.S. *Porthleven*	Newport
Oct.	28	M.V. *Annie*	Plymouth
Oct.	31	S.S. *System*	Weymouth
Oct.	31	S.S. *Radstock*	Newport

Par Harbour Tide Table, November, 1925

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
		November		
Sunday	22	9.20	9.55	11.7
Monday	23	10.28	11.2	11.3
Tuesday	24	11.43	—	10.10
Wednesday	25	0.25	1.5	11.6
Thursday	26	1.41	2.15	11.7
Friday	27	2.46	3.14	12.1
Saturday	28	3.37	4.1	12.7
Sunday	29	4.24	4.47	12.9
Monday	30	5.7	5.30	12.10
		December		
Tuesday	1	5.49	6.8	12.10
Wednesday	2	6.25	6.44	12.7
Thursday	3	6.59	7.16	12.2
Friday	4	7.32	7.50	11.9
Saturday	5	8.6	8.23	11.5
Sunday	6	8.42	9.2	11.0
Monday	7	9.25	9.48	10.8
Tuesday	8	10.14	10.41	10.1
Wednesday	9	11.14	11.49	9.10
Thursday	10	—	0.25	9.11
Friday	11	1.2	1.34	10.4
Saturday	12	2.4	2.32	11.2
Sunday	13	2.59	3.24	11.11
Monday	14	3.48	4.11	12.7
Tuesday	15	4.35	4.58	13.1
Wednesday	16	5.23	5.46	13.4
Thursday	17	6.11	6.35	13.6
Friday	18	6.56	7.19	13.7
Saturday	19	7.42	8.7	13.4
Sunday	20	8.30	8.55	12.11
Monday	21	9.21	9.48	12.5
Tuesday	22	10.15	10.45	11.7
Wednesday	23	11.16	11.50	11.0
Thursday	24	—	0.26	10.9
Friday	25	1.0	1.37	10.10
Saturday	26	2.9	2.40	11.3
Sunday	27	3.10	3.38	11.8
Monday	28	4.4	4.28	12.0
Tuesday	29	4.51	5.13	12.1
Wednesday	30	5.33	5.52	12.2
Thursday	31	6.11	6.30	12.2

E. CLEMENS, Harbour Master.

Penzance Shipping

October 2, S.V. *Ludwig*, to Helsingfors, 290 tons.
October 16, S.V. *Valdemir*, to Gothenburg, 260 tons.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BARNES AND SEAGER, LTD., Portsmouth, paper manufacturers. Registered October 7 (by order on terms), £2,000 mortgage, to L. W. S. Porter, Langhurst, London Road, Portsmouth, draper; charged on 308 and 310, Commercial Road, Portsmouth, and 15, 17 and 17A, Staunton Street, Landport. *—. March 17, 1925.

CENTRAL CORNWALL CHINA CLAY CO., LTD., St. Blazey.—Registered October 17, £3,050 debentures, part of £10,000; general charge. *£16,950. July 25, 1925.

COX AND CO. (HIGHBRIDGE), LTD., brick and tile manufacturers. Registered September 28, mortgage, to Bank; charged on properties at Highbridge and Burnham-on-Sea; also registered September 28, £2,700 debentures; general charge (subject to said mortgage). *Nil. December 31, 1924.

CRABTREE (CHARLES) (BINGLEY), LTD., paper makers.—Registered October 27, £1,100 mortgage, to Bingley, Morton Shipley and Keighley Permanent Benefit Building Society; charged on Tube Mills, and 22, 24 and 26, Ferrand Street, Bingley. *£256 11s. 8d. November 17, 1924.

USK PAPER MILLS CO., LTD., Cardiff.—Registered September 30, mortgage to Bank; charged on Usk Paper Mills, Crickhowell, with machinery, etc. *Nil. April 25, 1924.

China Clay Exports for October

RETURN showing the exports of China Clay: the produce or manufacture of the United Kingdom; from the United Kingdom to each country of destination; as registered during the month ended October 31, 1925.

Country of Destination.	China Clay. Quantity. Tons.	China Clay. Value. £
FOREIGN.		
Finland	5,785	9,447
Esthonia	760	720
Latvia	419	505
Sweden	2,745	4,862
Norway	873	1,642
Denmark (including Faröe Islands)	896	2,200
Germany	2,032	6,618
Netherlands	4,341	8,409
Belgian Congo (including Belgian Ruanda and Belgian Urundi)	3,060	6,172
France	2,588	3,881
Spain	1,436	3,104
Italy (excluding Fiume)	3,534	8,080
Roumania	2	7
Egypt	10	40
China (exclusive of Hong Kong, Macao, and leased territories)	—	3
United States of America	33,225	71,247
Mexico	170	757
Colombia	—	3
Chile	—	2
BRITISH POSSESSIONS.		
Irish Free State	11	29
Cape of Good Hope	—	6
Natal	1	8
BRITISH INDIA—		
Madras	14	54
Bengal, Assam, Bihar, and Orissa	778	3,112
Other Ports	1,195	4,637
Australia	54	206
New Zealand	6	29
Canada	145	738
Total Foreign Countries and British Possessions	64,680	136,614

The China Clay Trade Review

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China Clay Transport Factors

THERE has been much speculation during recent months regarding the channels through which China Clay, china stone, and ball clay are dispatched, and the reasons why Par and Charlestown harbours receive increasing preference by certain shippers at the expense of Fowey. Several factors account for this, the chief being that the cost of transporting China Clay and allied products from Fowey is higher than it is from either Charlestown or Par for certain China Clay works in the vicinity of St. Austell that are not on the railway. In pre-Association days this advantage did not operate to the extent it does now, because prices were fixed free on board Par or Charlestown practically the same as they were at Fowey, and any benefit there accrued to the seller and not to the buyer. There are in the St. Austell district of the China Clay area of mid-Cornwall a large number of China Clay mines in the Gover Valley, St. Austell-Bodmin Road Valley, Tregrehan Valley and the Carclaze quarter which are not served by any mineral line sidings into their works, as are the majority of works in the Bugle, St. Dennis, and St. Stephens areas. Consequently, in order to ship their clay at Fowey, they have to stand the cost of road transport to St. Austell or St. Blazey stations, in addition to the G.W.R. rail cost from those stations to Fowey.

In the case of St. Austell the rail charges to Fowey are 3s. 5d. per ton, plus 1s. 6d. per sheet for covering the trucks. Now, the road transport cost of getting the clay from the works situated farthest from Charlestown or Par to either of those ports is 3s. 3d. per ton, plus 1s. per ton harbour dues at Charlestown and 9d. per ton at Par. So that for a total cost of 4s. 3d. at Charlestown and 4s. at Par, China Clay producers in the areas mentioned can get their clay on board ship, whereas if they shipped at Fowey they would incur the cost of 2s. 10d. (the charge for road transport to St. Austell station) plus the rail charges to Fowey of 3s. 5d., plus 1s. 6d. per sheet per truck—say, 2d. per ton (in cases where the clay is sheeted, and most of it is nowadays to protect it against moisture), a total of 6s. 5d. per ton. This represents a saving in favour of Charlestown of 2s. 2d. and of 2s. 5d. in the case of Par. Hence the growth in volume of China Clay and china stone dealt with in recent months by these ports.

It would be a mistake to deduce from these facts that these ports can ever become a serious menace to Fowey. They have not the same facilities for quickly loading such an enormous tonnage, and besides it must be borne in mind that, except in the areas mentioned, the G.W.R. have a network of mineral lines linking up the bulk of the China Clay mines with the direct rail system to Fowey which cut out for those mines the road transport charges which are incurred by mines not so favourably situated. Another factor operating against Par and Charlestown is that their harbours are too small to accommodate any but schooners and small steamers, so that they are cut off from participating in the tonnage that is dealt with at Fowey by the big ocean-going steamers to American and other distant ports. While Fowey is thus protected, there appears on the face of it a case in favour of a reduction in the rail rates between St. Austell and St. Blazey and Fowey in the case of works that have to bear heavy transport charges. Another point is the small quantity of China Clay that is conveyed direct to the home markets by rail. The quantity of China Clay and china stone dealt with in this way seldom exceeds 5,000 tons per month out of a monthly tonnage of between 70,000 and 80,000 tons (compared with the export figures the home trade is less than a third of the total volume of business done). The reason for the small rail tonnage compared with seaborne tonnage is that the former is far costlier and is favoured mainly by the potteries and other consuming firms who take delivery in truck loads for convenience and expedition. Most of the chief manufacturing centres are within easy distance of the home ports, consequently the bulk of the China Clay that goes to the paper mills situated on the Thames, the Humber, and Scottish estuaries, and the chemical and cotton industries on or adjacent to the Mersey and Manchester Ship Canal, take their supplies by sea from Fowey, Par, Charlestown and other western ports.

A much larger quantity of China Clay is being delivered in casks and bags than during the war and shows a tendency to revert to the pre-war dispatch of clay in this way. In bags the quantity is usually two cwt., and in casks five cwt. and 10 cwt. Most of the China Clay for the Indian market is dispatched in casks and a large quantity to the States. Bags are favoured by the Continental and some home markets. The advantage of this method of delivery is to the buyer who has consuming customers to whom supplies in limited quantities suit their business. The cost, however, is a serious item added to the ultimate price of the clay to the consumer. Nevertheless, the increased use of casks and bags means good business for the coopers and sack merchants.

The Need for Looking Ahead

A contributor to this month's issue draws the attention of the industry to the necessity for anticipating the possibilities of diminishing supplies and the prospects of areas at present untouched. But not only in the question of supplies is this attitude essential. From time to time we publish information which goes to prove that America is not standing still in the matter of China Clay production. Extensive research is being carried out, not only on the question of fresh sources, but also on production methods and industrial application of the home clays. True, it has been admitted on more than one occasion that for some purposes no American China Clay can compete with the Cornish clays—at present. The substantial export figures would appear to confirm this, but it will be unwise of any producer to rest content with present conditions. If exploration, research, and intensive organisation can assist in home production, British merchants may rest assured that America will not fail to exploit them all to the full. Only by research and consistent service can Cornish China Clay producers assume with safety that the U.S.A. market is a safe outlet. An attitude of indifference to competition is unwarranted. Rather should the industry strive to make itself indispensable.

Research on Mineral Fillers

Increasing Application in Industry

MINERAL fillers are already very largely used ground in many industries. In the case of China Clay and China Stone these are used ground in paper, cotton and other textile fabrics, pottery, and other industries. Particular interest, therefore, attaches to recent investigations by the United States Bureau of Mines into the production and preparation of fillers, with special references to processes for securing fineness of grain. The number of mineral fillers used in manufactures is steadily increasing, the most extensively used being kaolin (China Clay), China Stone, chalk and limestone, silica, ochre, mica, talc, gypsum, barytes, graphite, slate, and diatomaceous earths.

The uses to which these minerals are put depend upon such properties as colour, specific gravity, hardness, nature of the surface, and the shape of the particles. Generally these fillers are used as chemically inert substances, to fill voids or to impart colour; but in some cases they exert an influence on the physical properties of the finished article. For example, powdered barytes and pulverised marble, when used as fillers in the preparation of rubber, impart quite different properties to the rubber compound. Mineral fillers are used in the manufacture of wallpaper, rubber, paint, linoleum, oilcloth, plastic and other cements, polishing and abrasive powders, matches, textile products, artificial slates, gramophone records, foundry facings, toilet requisites, clarification of oils, pottery ware, glazes, artificial stone, and road-asphalt mixtures. It is worth while, therefore, to examine more closely some of their properties.

Fineness of Grain

One of the most important properties is the size of the grains and the proportion of coarse to fine particles that can be obtained by grinding them. The United States Bureau of Mines have found that screening is not a satisfactory method, because of the difficulty in obtaining really good screens of the finer meshes. In fact, the finest screens, with 300 to 350 meshes to the inch, have a nominal opening of 40 to 50 microns (1 micron = 0·001 mm.), whereas high-grade fillers have generally an average grain size of less than 15 microns, or about one-third of the above-mentioned screen openings. Moreover, even these are by no means uniform, the individual holes in the screens often differing in size by as much as 30 to 40 per cent.

In the case of special fillers, therefore, other methods of determining fineness of grinding have been devised. These consist in principle in separating the product into distinct fractions of different grain sizes. Thus, for determining the fineness of Portland cement, the United States Bureau of Standards have designed a method of air analysis. It is regarded as doubtful whether satisfactory air separation of grains finer than 10 microns can be made, whereas some fillers, such as kaolin, have more then half the grains less than 5 microns in diameter. A more satisfactory method is elutriation by currents of water flowing at different velocities. The size of particles carried is related to the velocity of flow, according to Schone's formula, by the equation $D = 0{\cdot}0518 \frac{V\ 0{\cdot}636}{s-1}$ where D is the maximum diameter of a spherical particle, V is the velocity of flow in millimeters per second, and s is the specific gravity of the substance. By this means the sample can be separated into fractions, but there still remains to be determined the average grain of each fraction, which can best be done by microscopic measurement and count of each fraction.

Definite Physical Properties

The Bureau of Standards found that there is no fixed average for each fraction even of the same mineral. But each mineral, when pulverised, produces grains with definite physical characters. The shape of the grains, for example, depends upon the crystalline structure of the mineral, its cleavage plains, hardness and toughness.

Two classes of mineral powders are recognisable. In the first are included products resulting from the weathering or alteration of other minerals, such as kaolins, ochre and umber, and rotten-stone, the siliceous powder resulting from weathered chert or siliceous limestone. Materials of this kind may require treatment by grinding to break up the lumps or aggregates, but they do not need crushing in the sense of breaking down crystalline structures. The second class need the application of considerable force in crushing, to overcome crystal cohesion. Examples of this latter class are barytes, calcite, mica, talc, graphite, slate, and silica from quartz. It is characteristic of minerals of the first kind to form powders having grains of low average size, and a large percentage of them are very fine indeed, even ultramicroscopic. The minerals of the second class yield distinctly coarser powders, often requiring intensive grinding to reduce them to an average of 5 microns or less. These differences can be appreciated by comparing whiting formed from crushed marble, powdered oolite, or chalk. Marble flour retains a crystalline structure even when ground down to what is known as gilder's grade. Oolitic limestone flour still retains a crystalline structure, but the grains are less angular and less smooth than marble flour. Whiting from chalk more generally resembles the amorphous structure of minerals of the first class. The grains are more rounded and their surfaces are rougher, while there is a larger percentage of particles below 5 microns in diameter.

The Bureau enlisted the services of manufacturing companies which had facilities for co-operating in the investigation of new uses for slate dust. The rubber companies were supplied with slate flour of such a fineness that 80 per cent. would pass through a 200-mesh screen. Out of eighteen reports received, eleven were favourable and seven were unfavourable. The chief causes of failure was ascribed to the alleged influences of slate dust upon the tensile strength and wearing qualities of the rubber; but it was considered by some that better results would have been obtained with a finer ground powder.

China Clay Geologist's Distinction

AT the recent meeting of the Royal Geological Society of Cornwall at Penzance, the president, Mr. F. J. Stephens, F.G.S., of Camborne, handed Mr. J. M. Coon, St. Austell, the Bolitho Gold Medal for 1925, for research in China Clay, and remarked that this medal was awarded for meritorious services to the geological and mining interests of Cornwall. Mr. Coon had read valuable papers on the subject, and the Society felt that by the gold medal they were paying Mr. Coon a worthy tribute and trusted he would continue with further researches.

Mr. Coon returned thanks, and said that in the year 1855 the output of China Clay from Cornwall was about 60,000 tons per annum, and in 1875 about 134,000 tons from Cornwall and Devon. By 1891-92 the output from the two counties had reached 504,000 tons. In 1913 the output rose enormously to approximately 930,000 tons, and probably it would have gone to 1,000,000 but for the outbreak of the war.

Mr. E. H. Davison, B.Sc., F.G.S. (Camborne School of Mines), was the author of a paper on "The variation in the Cornish granite and its relation to ore deposits." The author was of the opinion that the several granite outcrops in Cornwall were all parts of one huge underlying mass.

Colonel E. H. W. Bolitho was elected honorary treasurer and trustee, Mr. Pearse Jenkin a member of the Council, and Mr. W. P. Simmons, curator. The balance-sheet showed a debit of £21, with about £15 still to come in.

Load Tests for Refractories

IN the construction and operation of metallurgical and industrial furnaces, it is highly desirable to have accurate knowledge as to the load that refractories will carry without deformation when heated to the intense temperatures developed in the furnace. The ceramics experiment station of the U.S.A. Bureau of Mines, in co-operation with Ohio State University, has been conducting an intensive study of the effect of furnace conditions on the so-called load test for the limit of strength of a refractory. This work, now brought to a close, has yielded fundamental data on the effects of temperature, time of heating, rate of increase of temperature, and other factors affecting the physical condition of the brick. These data have been reduced to simple charts and diagrams, so that the furnace operator can easily follow the reactions that may be expected for various conditions of operation, for a large variety of refractory materials.

Improvements in Pumping Engines

BY CHINA CLAY "CAPTAIN."

THE pumping engines engaged in pumping liquid clay from the China Clay mines are representative of almost all the stages of the development of pumping plants during the last 100 years. As we have written before, water-wheels were probably the first step after the man-power hand-pump. There are still overshot water-wheels pumping clay, and very efficient and economical engines they are, if a sufficiently large stream of water is available to work them. Then the rotary beam engine with its large fly-wheel, or, maybe, the beam or draught-engine would follow next in order. I know of one with "St Austle Foundry 1855" cast in its beam. The captain in charge facetiously remarked the other day that his firm were going to give it old age pension shortly, as it was a septuagenarian; still, they were very reluctant to do so, and although he knew it was old and in some respects out of date, yet he feared that no modern pump or engine would last 70 years to be called old-fashioned. The only reason given for scrapping it was its great coal consumption. There was nothing else wrong with it, and the actual working parts would with ordinary care last another 50 years at least.

Passing of the Steam Pump

There are other kinds of steam-engines—horizontal and semi-portable—used to work the plunger pumps which are still so largely used. Steam tangye pumps, and the "pulsometer" pumps are sometimes used in an emergency. But it would appear that the day of the *steam*-pumping-engine is passing and very few firms nowadays put in this type. The internal-combustion engine is almost everywhere taking its place, and suction gas engines, oil, and crude-oil plants may be heard "barking and coughing" in all directions. These, and the centrifugal pump, will no doubt eventually supersede the old beam engine and Cornish plunger; not because they are more reliable or less likely to breakdown, but simply for economy; from the *fuel* standpoint the saving is enormous, and there are other factors which help to make the modern pumping plant more economical.

Take the old beam engine and the Cornish pump. The engine-house had to be built 3 stories high and the front wall strong and massive enough to bear a "live" load of, say, 50 tons, reckoning a 15 ton beam-bob, the main-rod outside, and the steam on the piston inside. To make it stand the vibration it had to be built with a strong mixture of cement and large cut stone—a costly process. Then, to accommodate the Cornish plunger and place it in juxtaposition with the beam, a "shaft" had to be sunk, and "level" driven—again a very costly process. Then, to make provision for "sinking"—the future deepening of the pit—the shaft and level had to be some 10, 15, or 20 fathoms deeper than the "bottoms." That was one of the grave defects of the old system. I know a clay mine where a beam engine and Cornish pump were installed years before the war, and they still have 15 fathoms to "sink." It is a fairly large pit with an output of from 15 to 20 thousand tons per annum. Can anyone exactly compute what it has cost them to pump all their clay and spring and storm water 90 ft. higher than they need have done during all these years?

Disadvantages of the Centrifugal

The modern pump (*i.e.*, the centrifugal) need not be so placed; it does not require a shaft; fixed just low enough to drain the "dog's-hole," quite a shallow pump is sufficient.

But as there is never an advantage without a corresponding disadvantage, so it is with the centrifugal as compared with the Cornish plunger. In the case I have just quoted, the centrifugal has the advantage, but when it comes to abnormal times—during storms and sudden floods—the centrifugal, or rather the motor attached to it, becomes a source of anxiety. It caused no harm to "drown the old plunger," but the motor must not become submerged, therefore special precautions must be taken. It must be placed on a portable platform, so that it can be withdrawn if the flood is likely to drown it. I have seen it fixed on a kind of inclined truck and pulled up with a crab-winch during an emergency. Probably someone will invent a convenient automatic safety device for the motor-impelled pumps. Why not place them on a water-tight steel plate barge? The suction and delivery pipes having a sufficient length of armoured hose to allow the barge to float as the water rises, it would relieve the mind of the "captain" or night-shift boss to know that even if the water rose above the normal level, their pump was capable of working on the water, and without breaking a single joint it would successfully outride the storm. If this could be done successfully it would remove one of the objections to superseding the old pump, especially during the stormy winter months.

Newsprint Production

Great Possibilities of U.S.A. and Canadian Markets

A NEW Continental record of 2,900,000 tons of newsprint paper production was made in North America in 1924, with Canada as the determining factor in the increase over the previous year. This is welcome news to China Clay producers, whose product is used as a coater on a large scale.

The United States mills made 1,471,000 tons of newsprint in 1924, a decrease of 14,000 tons from 1923, and of 40,000 tons from the high mark of 1920. Canadian newsprint production amounted to 1,353,000 tons, an increase of 87,000 tons from 1923, and 54 per cent. more than in 1920. The one modern newsprint mill in Mexico made a little over 11,000 tons, and a similar mill in Newfoundland contributed 65,000 tons to the Continental total, which exceeded 60 per cent. of the world production of this essential substance.

With the production of newsprint paper in Canada only 9 per cent. behind that in the United States in 1924, admirers of the Dominion anticipate that the rapidly rising curve of Canadian tonnage will soon cross the stationary line of United States newsprint manufacture. With only a few thousand tons of domestic newsprint exported in 1924, publishers in the United States used nearly nine-tenths of the Canadian production in addition to 156,000 tons imported from Europe. The consumption was 50,000 tons in excess of the record-making total of 1923, and 28 per cent. more than in 1920, the latter in its turn being a record to that date. On a per capita basis, newsprint consumption in the United States has grown from 4 lb. in 1860 to 16 lb. in 1900, and to 50 lb. in 1923 and 1924.

Growth of Newspapers

The recognised directory of the trade lists more than 22,000 newspapers in North America at this time, with an increase of nearly 200 in number during the past year. About 10 per cent. of the total listings are daily newspapers, and the English language dailies in the United States have circulations amounting to 33,000,000 copies of the daily issues and of more than 22,000,000 copies of the Sunday issues. During the past five years the dailies have increased their circulation by 25 per cent., and the Sunday newspapers by 42 per cent. Upon examination of the United States newspapers which have circulations in excess of 100,000 copies each, we find that the daily issues averaged 28 pages in 1924, and the Sunday issues 103 pages, contrasted with 23 and 79 pages respectively, in 1920. The most marked characteristic of the metropolitan newspaper to date has been its steady increase in size and circulation. There is now a copy of a daily newspaper published for every $3\frac{1}{2}$ inhabitants in the United States, or more than one for every family, which shows the far-reaching daily newspaper habit. The total volume of newspaper advertising in 1924 was practically the same as in 1923 and in 1920. Periodical advertising, while 3 per cent. greater in space filled in 1924 than in 1923, was still 15 per cent. below the high mark of 1920.

Newsprint production in North America has increased at an average rate of nearly 7 per cent. compounded annually for the past 25 years. The new mills and additions to existing mills now under construction, or planned for, will bring the capacity of the North American industry up to 12,000 tons daily in 1926, unless some mills should find it more profitable to change to other types of operation.

New Sources of China Clay

The Necessity for Looking Ahead

CHINA Clay is being produced at the rate of approximately 800,000 tons per annum. At a moderate estimate, three tons of overburden, rock, etc., have to be removed for every ton of China Clay produced, so that China Clay working accounts for the removal annually of about 2½ million tons of solid matter from the clay-bearing lands of Cornwall and Devon. The China Clay produced in Devonshire may for all practical purposes be neglected as insignificant compared with the amount produced in Cornwall. One has only to look at the vast craters or excavations which have been made during the last fifty years to realise that if the production of China Clay is to continue and increase as it has done, new sources will have to be found. It may not be immediately necessary, but there is wisdom in looking ahead. Some of the older pits in the Mid-Cornwall area are becoming exhausted, and with many the cost of removing huge quantities of rock and masses of overburden from around the sides of the very deep pits in order to work the bottom clay, is becoming so expensive as to make them unprofitable working propositions.

Possibilities of Dartmoor

In the heart of the Bodmin and Launceston Moors there are large tracts of clay bearing land which will be developed one day, but it is more likely that the big source of supply will be the Dartmoor area. Mid-Cornwall has benefited in the past by the fact that it has been so easy and comparatively inexpensive to put the clay free on board vessels at Cornish ports, especially such a port as Fowey which caters for ocean-going ships. There are even now a number of large clay works in full operation on Dartmoor and others are in course of development. There is easy and reasonably cheap access from this area to Plymouth, which is well served by certain regular cargo shipping lines not calling at Fowey.

A large quantity of clay is railed from mine to destination every year. The cost of rail transport from the Dartmoor area to most of these destinations is less than the cost from the Mid-Cornwall area to the same places. This means an appreciably saving to the consumer who buys his clay free on rail at the mine. In the past, the cost of transport has prevented this new area from being exploited, but new methods of production and the ease with which pipe lines can be laid down over long distances, will make easily possible and profitable what has, in the past, been impracticable or at least unprofitable.

From the point of view of development, the adoption of the practice of laying pipe lines to connect distant fields with the railway or port may one day prove to be a vital step to progress.

E. J. L.

The Manufacture of White Porcelain

IN order to produce a good white body in the manufacture of porcelain it is essential to employ pure materials and develop their plasticity to the utmost capacity. As the type of filter-press used greatly influences plasticity, care should be taken that it is so constructed that the cakes produced are thin and uniform. These cakes should be kept not less than 24 hours before being put into use. Whiteness of the ware is improved by the employment of small proportions of dolomite, magnesite, or whiting, and by the use of a blue stain such as cobalt blue.

Greater translucency may be secured by the addition of about one per cent. of lime or magnesia. Therefore, their employment is sometimes considered preferable to whiting in mixtures. China and Ball Clays should be sufficiently blunged to make a thick slip, but on no account should blunging be continued unduly. Flint should be washed very fine and kept in a slip state as long as possible. By fine washing the setting of flint in the blunger may be avoided. The addition of coarse flint in a body, instead of flint of finer grains, may be responsible for crazing. Several beneficial results can be obtained from "ageing" of bodies. Their strength is increased when "aged" for seven or eight months, particularly when China Clay only is used in mixtures. The production of irregular shapes is greatly facilitated by the "ageing" of bodies, which is also instrumental in producing whiter goods, as by its agency a smaller proportion of Ball Clay proves sufficient when used in a mixture. Ball Clay tends to reduce porosity. It sometimes proves useful, however, in reducing the proportion of felspar employed.

Burning of the bodies should be carried out under properly controlled oxidising and reducing conditions. Goods made with "aged" bodies can be more uniformly burned than fresh ones. A number of experiments made on the burning range of different bodies composed of varying proportions of kaolin, flint, felspar and a small proportion of whiting were conducted at or above cone 10. When the foregoing materials were mixed in the requisite proportions, they were ground wet in a ball mill, lawned, filter-pressed and the resultant cakes made up into trial pieces. By the addition of an increased proportion of felspar, porosity was reduced without at the same time reducing the burning range to any great extent. In those bodies containing from 46 to 65 per cent. kaolin and from 13 to 28½ felspar there was little variation in the softening point, but a greater difference occurred when the proportion of kaolin was substantially increased. Those bodies containing from 54 to 62 per cent. kaolin with 1·5 per cent. whiting vitrified at a slightly lower temperature than those containing less kaolin and felspar. The effect of variation in the proportion of flux was less as a greater amount of clay was employed.

Use of Ball Clay

In bodies containing kaolin, felspar, flint and Ball Clay the most successful results were obtained from those fired at cone 13–14 with the following proportions: 46·5 per cent. clay, 36·5 flint, and 14·2 felspar. The employment of Ball Clay tended to reduce the burning range and was sometimes responsible for overburning of the ware. It was considered advisable to reduce the employment of Ball Clay to the minimum. Overburning was caused at a lower temperature and the burning range shortened when lime or magnesia were present in mixtures. The maturing point was hastened when the latter was used, but not in those bodies containing lime.

China Clay in Sugar Refining

AMONG the many uses of clay of which the general public, and indeed, many clayworkers and merchants are quite unaware, is its employment for bleaching loaf-sugar. This sugar is made by filling conical metal moulds with a concentrated syrup, which gradually crystallises and solidifies. The greater part of the liquid is allowed to drain away through a small hole in the apex of the mould. The resultant sugar-loaf is not white or of first-class quality, as some of the coloured molasses still remains in the interstices between the crystals by capillary attraction. The loaf is also soft and lacks the firmness required. It is to impart this firmness and to produce a perfectly white loaf that clay is employed.

The loaf is removed from the mould, the outer crust containing a larger proportion of coloured matter than the remainder is cut off, and a hollow is scooped out of the base of the loaf. The loaf is then replaced in the mould and the hollow portion is lined with clay paste about ⅛ in. thick. By a process of osmosis, the water in the clay enters the sugar-loaf forcing the molasses before it and forming a saturated solution of pure sugar. As this solution percolates through the loaf it drives the colouring matter and molasses before it to the apex from which they drip away. The solution of sugar gradually crystallises, forming a crystalline cement which consolidates the crystals forming the loaf and gives the latter the desired strength and solidity. The clay is usually removed once and replaced by a fresh quantity of clay paste; sometimes several treatments with clay are applied, but two usually suffice. The clay used is a white China Clay which must be plastic enough to retain an ample supply of water, but not excessively fat. It is kept wet by adding water to it as required.

Some sugar manufacturers avoid the use of clay by pouring a concentrated solution of pure sugar into the hollowed portion of the sugar-loaves. This solution behaves in a similar manner to the water and drives the colouring matter in the loaf down to the apex. As the pure sugar crystallises it binds the other crystals into a firm mass. Such a solution avoids the labour and expense of using clay and the risk of leaving some clay in the loaf, and it also causes less wastage of sugar. When pure sugar is not available, however, the use of clay affords an ingenious and simple means of obtaining the same result.

The Weathering of Clays

Physical and Chemical Changes due to Exposure

THE changes which take place in the properties of clays during their exposure prior to working are of a complex character and are usually summed up in the general term "weathering." The physical and chemical changes which occur may often be the result of several causes acting simultaneously, and it may be difficult to ascertain how much of the final result is due to each of the agents at work. There is still some obscurity with regard to some of the changes which take place, and divergent views are held as to the precise nature of such processes as those which result in the decomposition of the felspars and other silicates which occur in clays, according to Mr. J. W. Rees, B.Sc., in a paper presented at the Clay Convention, 1925.

Weathering may be classified under three general headings —namely, physical, chemical, and organic.

Physical weathering comprises those processes resulting in a breaking down of the clay into small particles; by the increase in the exposed surface area thus brought about, the freer action of chemical weathering agents is facilitated. Conversely, the solution or breakdown of cementing material in mineral aggregations which may be present increases the number of free particles and exposes them to physical weathering agents. The most important agencies of physical weathering are the volume changes following on changes in temperature and the expansion which occurs when water freezes. With sudden changes in temperature the disintegrating effect will be most pronounced. The pressure exerted when water absorbed in the pores of clay is frozen is a factor of considerable importance in weathering. Although in the physical weathering of rocks wind may be an important agent, it does not play much part in the weathering of clays.

Important Chemical Factors

The most important chemical factors in weathering are solution, hydration, hydrolysis and oxidation. Some of the alkali and lime compounds may be removed by direct solution, whilst in other cases one or more of the products of hydrolysis or hydration may be removed by water solution. For example, the alkali felspars very slowly react with water, forming kaolinite, colloidal silica, and alkali hydrates, the two latter being removed by solution. Very often the decomposition of the felspars is incomplete, only part of the alkali and silica being removed, leaving small plates of white mica behind. The iron and magnesian micas which may occur in clays are readily removed by weathering, especially if non-sulphide impurities are also present. If iron sulphide is present as the mineral marcasite, it is readily oxidised by atmospheric exposure to ferrous sulphate and ultimately to sulphuric acid. Pyrites is much more stable, and is only very slightly affected by weathering.

The precise action of organisms on bacteria in affecting the weathering of clay is still, to some extent, a matter of speculation; but organic weathering is, with some clays, a factor of considerable importance. Mr. Hugill, and myself, said Mr. Rees, have recently concluded, from the results of some weathering experiments, that the oxidation of iron sulphides takes place largely through the action of a bacillus, the oxidation of marcasite in clays which have been carefully sterilised being completely inhibited. We are now endeavouring to isolate the particular bacillus responsible; if it can be isolated and cultivated it opens up the possibility of inoculating clays and thus considerably expediting the removal from them of these iron sulphide impurities.

Experiments we have made also indicate that acid and other impurities which may be present in the rain water in industrial districts have an effect on the rate of weathering of clays.

The increase in plasticity and general workability of many clays, which is brought about by weathering, is due mainly to the breakdown of the clay into small particles and to the effects of hydrolysis in increasing the colloid content of the clay.

Dye Adsorption of Clays

Relation to Behaviour in Rubber Compounds

THE relation between dye adsorption of clays and their behaviour in rubber compounds is the subject of an article by H. R. Thies in the November issue of *Industrial and Engineering Chemistry*. Clays of the same chemical type do not behave similarly when compounded in rubber; one type gives good cures and high tensile strengths, the other slow cures and inferior tensile strengths. These two types of clay adsorb different amounts of dye from solution, the clay which is good for rubber usage adsorbing the smaller amount of dye.

Ashley found that the adsorption of dyes by clays affords an approximate measure of their plasticity. He used malachite green and methyl violet. Gile and Middleton extended this work and formulated a rough quantitative method for the determination of the amount of colloid present in soil based on adsorption of malachite green, water vapour and ammonia vapour. Schidrowitz took out a patent using the adsorption power of clay for carrying an accelerator. Searle states: "The enormous power of adsorption possessed by colloids is due to their peculiar structure which gives them very great surface area—clay exhibits such adsorption." Arrhenius found that dyes were adsorbed in stoichiometrical proportion and that several indicators were adsorbed by the same clay in proportion to their molecular weight. Davies calls attention to the use of clay in medicine for its adsorption ability, and says it is probably this property that makes it desirable for use in rubber.

Experiments on Dye Adsorption

Weigel has shown that in 44 samples of Georgia clay, all prepared as pigment clay in the same manner, there is a marked difference in behaviour when cured in rubber compounds. Later, Bleininger tells us that the powerful adsorbing power of clays is well known, and that the clay takes up the basic ion—as a rule—the adsorption taking place according to the adsorption equation, but that the value of the latter as a criterion to distinguish between adsorption and chemical combination may be questioned. Bancroft states that the adsorption of lime by fuller's earth is equivalent to a 2 per cent. sulphuric acid solution.

With the foregoing information on the adsorption power of clays, and knowing the difference in their behaviour in rubber, a study was made of the relation of these two qualities as applied to rubber compounds. After preliminary experimentation, some good curing clay and some poor curing clay were shaken in a 0·1 per cent. malachite green solution, also in 0·1 per cent. solution of methyl violet, as follows: A 2-gramme sample of clay was weighed into a 25-mm. test tube and suspended in 50 cc. of the dye solution. This suspension was thoroughly shaken and allowed to settle for one hour, after which samples of the clear, coloured liquid were drawn off and compared in a Duboscq calorimeter with an accurately diluted standard for dye content. This method, using malachite green, was finally adopted as a standard procedure.

On completion of the foregoing examination it was found that in the methyl violet solution the poor-curing clay had adsorbed all dye present while the good one had not, but with malachite green the poor clay adsorbed a large amount of dye, the good clay little. In this instance the poor clay settled out of suspension much more slowly than did the good one, whereas in another test the poor clay even bleached a coloured mineral oil much better than did the good clay.

In trying to find a dye and a method that would give the widest differential adsorption for the two types of clay, the amount of adsorption with several dyes was determined, using 0·5 gramme sample of clay instead of 2 grammes. The results obtained further indicate that for exact determination of adsorption the clay ratio of the solution must be constant. For example, in some cases fewer milligrams of dye were adsorbed per gramme of good clay when a 0·5-gramme sample was used than when a 2-gramme sample was used. This, however, was never the case with the poor clay, although it was found to be universally true that for basic dyes the adsorption ability of clay that was good in rubber compounding was much less than the adsorption ability of the clay that was poor in rubber work.

China Clay Notes and News

Jetty Water Revenue

The report of the Fowey Town Council Water Committee shows that the jetty revenue for October amounted to £113 18s. 6d. This is derived from China Clay vessels for water supplied, and represents a considerable contribution towards the rates in the course of a year.

St. Dennis Clay Workers' Band

At the annual meeting the balance-sheet, presented by Captain Hill (honorary treasurer), showed that the year had opened with a balance of £31 14s. 5d., and had closed up with 9s. 7d. in hand. The total receipts were £176 11s. 3d., and expenditure £176 1s. 8d. Captain Hill was heartily thanked for the excellent way in which he had kept the accounts. The officers for the ensuing year were elected as follows: President, the Right Hon. H. D. McLaren; Chairman, Mr. R. Hooper, J.P.; Vice-Chairman, Captain F. Dyer; secretary, Mr. M. Kessell; Honorary Treasurer, Captain J. H. Hill; auditors, Messrs. A. W. Jenkin and E. Allen; Bandmaster, Mr. W. Juleff.

New Patent for Use of Alumina and Silica

222,151. Manufacturing Cementitious Materials. H. S. Spackman, Ardmore, Pennsylvania, U.S.A.—This invention consists in the manufacture—by melting the raw materials—in revolving furnaces, of low lime, high alumina cements, that is cements in which the alumina exceeds the silica, and in which the lime present after deducting that combined with the silica and other acids acting elements is only sufficient to combine with the alumina in ratios from $5Al_2O_3$, $3CaO$ to Al_2O_3CaO. The raw material is fed into the kiln preferably after mixing with water, as in the wet process for making Portland cement, so that it minimises dust losses which otherwise are apt to be a serious item in cost owing to the high cost of the raw materials used in producing low lime high aluminous cements. (Four claims).

£100,000 South-West University

There was a good attendance of members and guests at the St. Austell Rotary Club on December 9. Principal Moberley, of Exeter College, Exeter, and recently appointed vice-Chancellor of Manchester University, in the course of an extremely interesting address, dealt with the present campaign in favour of the setting up of a University for the South-West, of which Exeter College is to be the nucleus. He dealt with the development of the movement for the establishment of provincial colleges to meet the increasing demand for University Education, which had grown beyond the scope of Oxford and Cambridge, and emphasised the value of a University education in the development of the intellectual, scientific, and industrial life of the country. He pointed out that one of the chief features of the University for the South-West would be the facilities offered for providing technical and scientific education in connection with industry, and expressed the hope that such industrial educational centres as the Camborne School of Mines, the Seale-Hayne Agricultural College, and the centre at Plymouth would be embraced by the University. He stressed the importance of receiving the necessary financial support to allow a worthy scheme, and appealed to his hearers to do all they could to help forward the movement.

Rotarian E. J. Hancock (vice-president), managing director of the West Carclaze and other China Clay companies, made appreciative reference to Principal Moberley's address, and welcomed his advocacy of such a fine scheme. He gave instances of the value of scientific education in enabling students to undertake research work, which he had found most valuable in his business as a China Clay merchant. He thought there was a great deal of scope in making the best use of existing resources and in developing the unexplored mineral wealth of the county. He had discovered through research a means by which China Clay treated in a certain way could be adapted to new uses, in one of which the commodity he supplied at £3 10s. per ton had replaced the use of a material costing £20 per ton.

Large Clay Vessel's Last Voyage

The largest barque ever loaded at Fowey is the four-master *Phyllis*, formerly the *Australia*, and flying the Italian flag, which recently sailed from Fowey to Genoa with a part cargo of 2,800 tons. She has been sold to Italy for breaking up, and aroused interest while in the harbour taking her last cargo.

China Clay Official's Golden Wedding

Mr. and Mrs. Murillo Yelland, of St. Stephens-in-Brannel, celebrated their golden wedding last month. They were married on November 20, 1875, at St. George's Church, Truro, by the Rev. P. E. Wrench. Mr. Yelland was employed at the Trevargus china stone quarries under Thomas Olver and Co. for over 45 years, and on his retirement a year ago went to reside in St. Stephens. Mr. and Mrs. Yelland both enjoy fairly good health and have been congratulated by many relatives and friends.

Fowey China Clay Ship Wrecked

At about midnight recently at Bridlington, over 2,000 people witnessed the return of the lifeboat through a raging sea. It had been to the rescue of the crew of the three-masted schooner *Mary Watkinson*, from Fowey, and five Bridlington fishermen, who in the morning had gone to the assistance of the vessel which had, during Sunday night in a dense fog, run ashore under Flamboro' Cliff. The schooner was in a dangerous position, and when, about 8 in the evening, a south-westerly gale rose, the crew showed signals of distress by burning flares. The Bridlington lifeboat was launched and the Life-Saving Company hauled the rocket apparatus across rough snow-covered fields to the cliff edge. The lifeboat was just in time to save all on board, for it is reported that the hull of the schooner burst a minute or two before the men were safe in the lifeboat. Captain Harry Randall, of Fowey, was the last to leave his ship, dragging with him into the lifeboat a small tin box, which, when it was opened ashore, was found to contain the ship's cat. The schooner, which is owned at Runcorn, was from Fowey for Newcastle with China Clay.

Death of Mrs. John Lovering

After being an invalid for many years the death has occurred at her residence, Cosgarne, St. Austell, of Mrs. Lovering, aged 73, wife of Mr. John Lovering, senior partner of the China Clay firm of John Lovering and Co.

At the funeral the China Clay industry was largely represented. The interment at the cemetery was preceded by a brief service at St. Austell Parish Church, conducted by the Rev. E. Roberts (vicar). The family mourners present were: Mr. John Lovering (husband), Mr. and Mrs. J. S. Lovering, Mr. and Mrs. Cecil Lovering (sons and daughters-in-law), Mr. and Mrs. W. T. Lovering (brother-in-law and sister-in-law), Messrs. F. R. Lovering and Howard Lovering (brothers-in-law), and Mr. and Mrs. Reginald Lovering (nephew and niece-in-law). Amongst a large number of followers, most of them connected with and representing China Clay firms, were: Messrs. E. W. Penrose, J. H. Peters, R. Pearce, A. Harris, and E. Cocks (members of the office staff), Messrs. J. W. Higman, F. Parkyn, H. Nicholls, T. C. Ellis, W. G. Pool, H. Stocker, M. F. Hichins, G. H. Grenfell, E. J. Hancock, R. R. French, S. Benson, W. Luke, J. R. Gaved, S. B. Perry, A. Perry, S. J. Dyer, J. Hooper, J. W. Higman, Junr., F. S. Liddicoat, T. Martin, J. Martin, W. Graham, Dr. H. Newcome Wright, Dr. W. Gilchrist, H. W. Higman, A. P. Coode, P. M. Coode, E. Snow-Martin, W. H. Bettison, J. M. Coon, W. A. Coon, F. A. Coon, G. Hicks, T. W. Couch, W. Dunn, W. Mutton, F. W. Mutton, W. Morton, T. J. Smith, W. H. Hichins, G. B. Dobell, N. F. Bellamy, W. H. Richards, S. P. Bunn, A. Ward (Summercourt), W. P. Northey, W. J. Adams, A. Reed, H. E. Warne, P. Prout, T. Prout, F. Hart, O. Sweet, J. P. Richards, Fred Stephens, E. Clemo, John Hancock.

There was a large number of floral tributes.

Of late years Mrs. Lovering was not much seen in public, but she was, nevertheless, of a kindly and generous disposition, and benefited many deserving causes by her unostentatious gifts. She was a great sufferer from arthritis, but bore her affliction with uncomplaining fortitude and patience.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—November, 1925

Arrivals

Date.	Vessel.	From.
November 3	*Treleigh*	Hayle
November 5	*Magrix*	Plymouth
November 9	*Carmenta*	Newlyn
November 14	*Beulonaise*	Falmouth
November 14	*Paquerette*	Morlaix
November 14	*J. M. Nielsen*	Kotka
November 14	*Lady Thomas*	Barry
November 19	*Porthcarrack*	Plymouth
November 20	*Lisa*	Frangsund
November 20	*Ada*	Falmouth
November 20	*Lady Roseberry*	Exeter
November 20	*C. and F. Nurse*	Falmouth
November 20	*Porthleven*	Cardiff
November 22	*Rothersand*	Falmouth
November 23	*Western Lass*	Penryn
November 24	*Gauntlett*	Falmouth
November 25	*Jane Banks*	Falmouth
November 26	*J. H. Barrow*	Falmouth
November 27	*Oak*	Plymouth
November 27	*Miriam Thomas*	Guernsey
November 28	*Hilda*	Plymouth
November 29	*Amphitrite*	Cardiff

Sailings

Date.	Vessel.	Destination.
November 4	*Treleigh*	Preston
November 5	*Magrix*	London
November 13	*Carmenta*	Rochester
November 19	*Porthcarrack*	Ridham
November 19	*Lady Roseberry*	Rochester
November 19	*Lady Thomas*	Barrow
November 20	*Beulonaise*	Dunkirk
November 21	*Paquerette*	Nantes
November 24	*Porthleven*	London
November 25	*C. and F. Nurse*	London
November 27	*Western Lass*	Runcorn
November 27	*Gauntlett*	Runcorn
November 29	*Oak*	Larne (Ireland)
November 30	*J. H. Barrow*	London
November 30	*Miriam Thomas*	Barrow
November 30	*Jane Banks*	Newcastle

Fowey Shipping—November, 1925

Arrived.	Name.	Sailed.	Destination.
November 4,	S.S. *Ville d'Etaples*	November 6,	Rouen
November 4,	S.S. *Hartfell*	November 11,	Barcelona
November 4,	S.S. *Alice*	November 6,	Preston
November 4,	M.V. *Isabel*	November 6,	Plymouth
November 4,	S.S. *Dorset Coast*	November 6,	Liverpool
November 6,	S.S. *Vechtstroom*	November 7,	Amsterdam
November 6,	S.S. *Joffre Rose*	November 10,	Runcorn
November 6,	M.V. *Margrietha*	November 10,	Terneuzen
November 6,	M.V. *Mayblossom*	November 9,	Gweek
November 6,	*Carmenta*	November 9,	Charlestown
November 6,	M.V. *Ann Elizabeth*	November 9,	Penryn
November 7,	S.S. *Blush Rose*	November 10,	Preston
November 7,	M.V. *Tormalind*	November 10,	Savona
November 7,	S.S. *Hayle*	November 11,	Ridham
November 8,	S.S. *Malrix*	November 11,	Antwerp
November 8,	S.S. *Southwell*	November 11,	La Pallice
November 8,	S.S. *Isabeletta*	November 11,	Fleetwood
November 8,	S.S. *Sturdee Rose*	November 10,	Terneuzen
November 8,	M.V. *Gustaf*	November 14,	Drammen
November 9,	S.S. *Scartho*	November 11,	Karlskrona
November 9,	M.V. *Locking Naval*	November 12,	Antwerp
November 9,	M.V. *Marie*	November 14,	Fredrikshald
November 9,	M.V. *Vestland*	November 19,	Sodertelze
November 9,	S.S. *Falmouth Castle*	November 12,	Manchester
November 10,	M.V. *Annie*	November 13,	Par
November 10,	S.S. *Mount Charles*	November 13,	Lancaster
November 11,	S.S. *Brynawel*	November 16,	Weston Pt.
November 11,	S.S. *Westdale*	November 14,	Liverpool
November 11,	S.S. *Shoreham*	November 14,	Weston Pt.
November 11,	*J. M. Nielsen*	November 14,	Charlestown
November 11,	S.S. *Norwich City*	November 19,	Portland Me.
November 12,	S.S. *Eltham*	November 13,	Preston
November 12,	S.S. *Dorrien Rose*	November 13,	Ghent
November 12,	S.S. *Goodig*	November 17,	Brussels
November 12,	M.V. *Isabel*	November 14,	Pentewan
November 13,	M.S. *Wilhelmina Naval*	November 17,	Harburg
November 14,	S.S. *Wearbridge*	November 23,	Philadelphia
November 14,	S.S. *Torpoint*	November 18,	Newlyn
November 15,	*Ingrid*	November 27,	Stockholm
November 15,	S.S. *Teesbridge*	November 24,	Portland Me.
November 15,	S.S. *Heather King*	November 18,	Bo'ness
November 15,	*Lady Daphne*	November 27,	Aylesford
November 16,	*Elakoon*	*	Leghorn
November 17,	*Valborg*	*	Genoa
November 18,	S.S. *Ferndene*	November 21,	Antwerp
November 18,	S.S. *Dorset Coast*	November 19,	Birkenhead
November 19,	S.S. *Monksville*	November 24,	Aberdeen
November 19,	S.S. *Pembrey*	November 24,	Ridham
November 19,	S.S. *Avanville*	November 25,	Preston
November 19,	S.S. *Harald Casper*	November 27,	Portland Me.
November 20,	M.V. *Crown of Denmark*	November 30,	Rochester
November 20,	S.S. *Joffre Rose*	November 25,	Preston
November 21,	S.S. *Denmark Maru*	*	Philadelphia
November 21,	S.S. *Gouwestroom*	November 27,	Amsterdam
November 21,	M.V. *Corrie*	November 30,	Harburg
November 21,	M.V. *Wietze*	November 30,	Harburg
November 21,	S.S. *Brier Rose*	November 25,	Fleetwood
November 22,	M.V. *Dietrich Hasseldieck*	November 27,	Harburg
November 22,	S.S. *Primrose*	November 25,	Rouen
November 23,	M.V. *Margot*	November 28,	Oscarshamn
November 24,	S.S. *Risoy*	November 28,	Grangemouth
November 24,	*Windermere*	*	Rochester
November 24,	S.S. *Otranto*	December 1,	Ancona
November 24,	S.S. *Falmouth Castle*	November 25,	Runcorn
November 24,	S.S. *Wheatfield*	November 27,	Bristol
November 24,	S.S. *Coaster*	November 28,	Tyne
November 24,	S.S. *Eskburn*	November 28,	Ridham
November 25,	*Erika*	*	Munkedal
November 25,	S.S. *Pansy*	November 27,	Hull
November 25,	S.S. *Dunmore*	November 27,	Pentewan
November 25,	S.S. *Blush Rose*	November 30,	Weston Pt.
November 25,	S.S. *Clara Monks*	December 1,	Runcorn
November 26,	S.S. *System*	December 1,	Gravelines
November 26,	S.S. *Pylades*	December 2,	Tayport
November 27,	S.S. *Dorrien Rose*	December 1,	Antwerp
November 27,	S.S. *Southwell*	December 3,	Rouen
November 27,	M.V. *Mayblossom*	December 1,	Pentewan
November 29,	M.V. *Anna Elizabeth*	December 3,	Gothenburg
November 30,	S.S. *Florentino*	December 3,	Genoa
November 30,	S.S. *Brier Rose*	December 3,	Garston
November 30,	S.S. *Dorset Coast*	December 3,	Birkenhead

* In Port.

Par Harbour Shipping—November, 1925

Arrivals

Date.	Vessel.	From.
November 2,	M.V. *Antigoon*	Dartmouth
November 5,	S.S. *Tanny*	Newlyn
November 12,	M.V. *Annie*	Fowey
November 12,	S.V. *Shortest Day*	Plymouth
November 15,	S.S. *Seaforth*	Newport
November 18,	S.S. *Elsie Annie*	Plymouth
November 19,	S.V. *S. F. Pearce*	Plymouth
November 20,	S.V. *Scone*	Torquay
November 20,	S.S. *Treleigh*	Portreath
November 20,	S.V. *Waterwitch*	Falmouth
November 21,	S.V. *Henrietta*	Mevagissey
November 22,	S.S. *Robrix*	Teignmouth
November 22,	S.V. *Hosianna*	Dartmouth
November 22,	S.V. *John Gibson*	Falmouth
November 26,	S.S. *Nancy Thomas*	Newport

Sailings

Date.	Vessel.	Destination.
November 2,	S.S. *Porthleven*	Antwerp
November 4,	S.V. *Flying Foam*	Poole
November 4,	S.V. *Dispatch*	London
November 4,	S.S. *System*	London
November 4,	S.S. *Radstock*	Plymouth
November 5,	S.V. *W. E. Gladstone*	Pentewan
November 5,	S.V. *Emily Embrich*	Weston Point

November 5,	S.V. *Yealm*	Pentewan
November 5,	M.V. *Hope*	Penryn
November 5,	S.V. *Gwendoline*	Plymouth
November 5,	M.V. *Antiggon*	Antwerp
November 6,	S.V. *Bulla*	Rochester
November 7,	S.S. *Tanny*	Penarth
November 9,	M.V. *Annie*	Fowey
November 13,	M.V. *William John*	Pentewan
November 14,	S.V. *Shortest Day*	Pentewan
November 14,	S.V. *Mary Barrow*	Gravesend
November 18,	S.S. *Seaforth*	Newlyn
November 19,	S.S. *Elsie Annie*	Rochester
November 19,	S.V. *Pearl*	Weston Point
November 21,	S.S. *Treleigh*	Preston
November 23,	M.V. *Annie*	Pentewan
November 27,	S.V. *S. F. Pearce*	London
November 27,	S.V. *Scone*	London
November 27,	S.S. *Robrix*	Greenhithe
November 28,	S.V. *Waterwitch*	Runcorn
November 30,	S.V. *John Gibson*	Rochester

Novembe Deliveries of China Clay

Aggregate Figures Up on Last Year

WITH 84,222 tons delivered in November, the deliveries of China Clay, china stone, and ball clay have reached 883,693 tons for the eleven months, against 830,031 tons for the corresponding period last year. The details are as follow :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
PORT.	1925	1924	1925	1924	1925	1924	1925	1924
Fowey	64,762	53,972	3,303	3,408	695	1,238	68,760	58,618
Charlestown	4,298	3,672	—	—	—	—	4,298	3,672
Par	4,003	5,052	240	458	—	—	4,243	5,510
Plymouth..	1,145	4,060	37	46	—	—	1,182	4,106
Falmouth..	120	—	—	—	—	—	120	—
Penzance ..	690	—	—	—	—	—	690	—
Looe	196	—	—	—	—	—	196	—
Newham...	223	—	—	—	—	—	223	—
By rail	4,510	4,790	—	—	—	—	4,510	4,790
November TOTALS .	79,947	71,546	3,580	3,912	695	1,238	84,222	76,696
October ...	78,597	80,197	5,405	3,693	5,680	2,821	89,682	86,711
September .	77,228	73,307	4,181	4,368	2,015	3,342	83,424	81,017
August	66,184	61,681	4,132	6,009	2,720	1,970	73,036	69,660
July	67,032	68,951	6,561	5,347	2,787	8,005	77,390	82,303
June	69,022	58,504	3,830	3,310	2,619	3,076	75,471	64,890
May	80,860	82,405	4,286	3,363	1,825	2,859	86,671	88,357
April	59,624	75,311	3,198	4,651	1,818	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February ..	66,863	52,244	3,436	1,575	614	1,118	70,713	54,937
January ...	74,490	56,686	2,056	3,978	3,050	1,567	80,046	62,231
TOTAL, 11 months .	814,064	755,023	43,641	44,358	24,978	30,650	883,693	830,031

China Clay Exports for November

A RETURN showing the exports of China Clay, the manufacture of the United Kingdom, from the United Kingdom, to each country of destination as registered during the month ended November 30, 1925.

COUNTRY OF DESTINATION.	CHINA CLAY. QUANTITY.	VALUE.
FOREIGN.	Tons.	£
Finland	1,557	1,357
Sweden	2,285	6,337
Norway	1,089	1,697
Denmark (including Faröe Islands)	467	634
Germany	2,928	7,350
Netherlands	3,740	7,124
Belgium	4,744	7,894
France	1,677	2,942
Portugal	16	63
Spain	2,076	4,645
Italy (including Fiume)	3,183	7,007
Greece	—	1
United States of America	18,612	41,095
BRITISH POSSESSIONS.		
Irish Free State	—	2
Channel Islands	7	13
Nigeria (including British Cameroons)	—	5
INDIA—		
Madras	110	440
Bengal, Assam, Bihar and Orissa	70	280
Other Ports	900	3,474
Australia	48	238
Canada	204	612
Total Foreign Countries and British Possessions	43,713	93,210

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALDERS PAPER MILLS, LTD., Tamworth. Registered November 19, £30,000 debentures and premium of 5 per cent. secured by Trust Deed dated November 11, 1925) ; charged on properties at Tamworth, etc. ; also general charge.

MELTHAM SILICA FIRE BRICK CO., LTD.—Registered November 17th, £10,000 debentures ; general charge. *£700. June 19, 1925.

SAMPSON SMITH, LTD., Longton, earthenware manufacturers.—Registered November 28, £5,200 mortgage, to Building Society ; charged on Sutherland Works, Barker Street, Longton, and seven messuages adjoining. *Nil. October 22, 1925.

Satisfactions

CAULDON POTTERIES, LTD., Stoke-on-Trent.—Satisfaction registered November 6, all moneys, etc., registered July 27, 1921.

YATES DUXBURY AND SONS, LTD., Heywood, paper manufacturers.—Satisfaction registered November 14, £150,000, registered November 7, 1921.

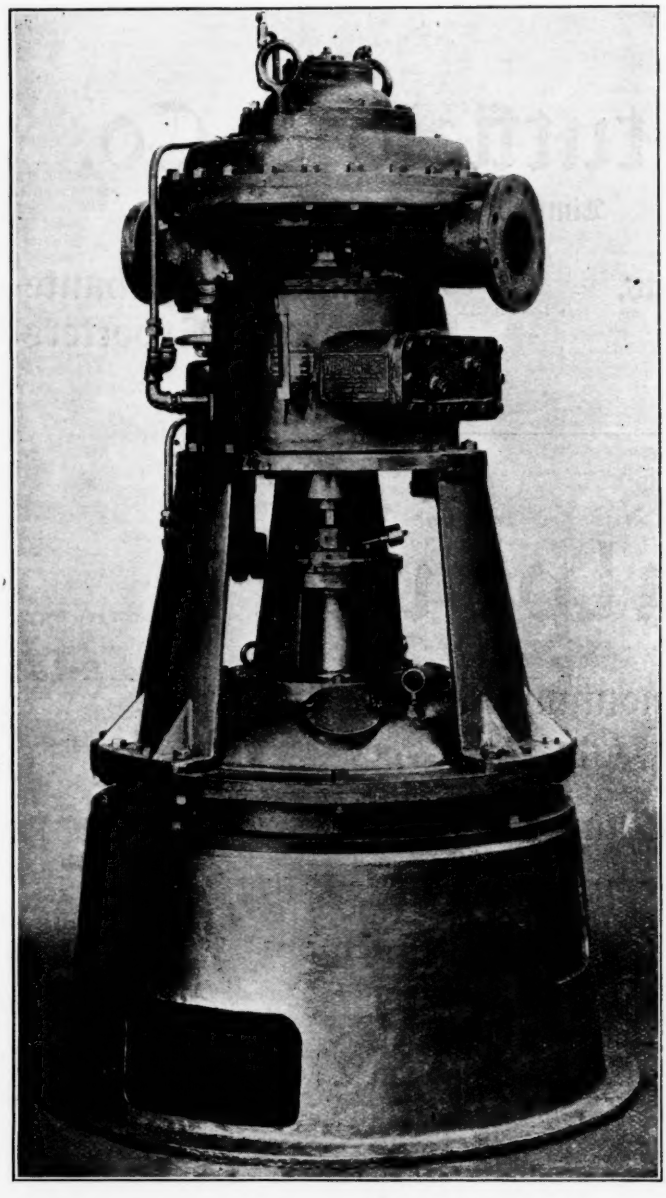
Utilisation of American Clays

THE results of a study of the utilisation of Georgia and Alabama clays as mineral fillers, recently completed by the U.S.A. Bureau of Mines, indicate that these clays, when prepared properly, can be used advantageously in the manufacture of paper, wall paper, rubber, paint, oilcloth, textiles, kalsomine, plaster, matches, and numerous other materials. The white clays or kaolins of Georgia and, to a small extent, of Alabama, have been utilised in the ceramic industry for many years. Some of these deposits have supplied clay to paper manufacturers, and a few have produced clay for use in rubber compounding and the manufacture of oilcloth and paint. As many owners and operators of clay deposits are unfamiliar with the different requirements for clays to be used as fillers, and so are unable to prepare their product for the market to which it is best adapted, the Bureau of Mines, in its endeavour to increase efficiency and economy, has studied the clays in question to ascertain the uses to which they could be most efficiently put. A study of the Georgia clays for ceramic use was the subject of an earlier investigation.

The general area in which the clay deposits occur extends as a belt across middle Georgia, into Alabama, and up to the northern end of the boundary between Alabama and Mississippi. This is part of the coastal plain region. The clay beds range in thickness from those too thin to work profitably, up to more than 40 ft. The thickness of cover ranges from a few inches up to depths that make stripping impracticable. At some places 50 to 60 ft. of cover has been stripped to expose the clay. The results of this investigation are given in Technical Paper 343, " Georgia and Alabama Clays as Fillers," copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D.C.

China Clay Imports for November

A RETURN showing the registered imports of China Clay including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of November, 1925, records two consignments, one to Germany, of 10 tons, valued at £14, and one to Belgium, of 434 tons, valued at £693, giving a total of 444 tons, valued at £707.



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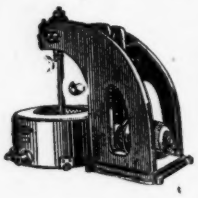

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